# ELECTRICAL ENGINEERING

**APRIL 1958**
**Vol. 77, No. 4**

***Published monthly by American Institute of Electrical Engineers***

## Contents

**Science and Technology in a Changing Environment** *E. W. Engstrom*
Scientist-Engineers needed for our national well-being must be technologically and scientifically trained in a long-range, not crash, program 283

**Entering the Machine Domain** *S. L. Seaton*
A discussion of those aspects of experimental psychology which are appropriate to entering the machine domain 289

**Precise Measurement and the Race for Technological Supremacy** *A. V. Astin*
The outcome of the race for technological supremacy depends to a large extent upon a country's level of measurement techniques 294

**Measurement of Television Field Strength** *H. T. Head*
New propagation curves are necessary for more accurate predictions of useful field strengths within the service ranges of television stations 298

**Remote Control Carrier Systems in Two-Way Closed-Circuit Educational TV** *J. R. Martin, R. N. Vandeland, G. W. Warnick*
Two-way closed-circuit television system in education is made possible if radio rather than video frequency distribution system is used 304

**Breaker Restriking and Arrester Destruction on a 220-Kv System** *M. C. Galiyano, C. A. MacArthur, W. F. Mackenzie*
An experience of the Pennsylvania Power & Light Co., involving damage during switching on a 220-kv system, is described 308

**Metallic Rectifiers for Shipboard Electric Systems** *C. L. Straub, H. G. Wiest*
Metallic rectifiers are finding increased use as d-c electric power sources on a-c powered ships 312

**Electrical Insulation Properties at Ultrahigh Temeperatures** *G. I. Duncan, M. M. Felger*
The era of high-speed nuclear propelled aircraft and missiles demands electronic equipment which is both temperature and radiation tolerant 318

**Education and the Science Frontiers** *T. J. Watson, Jr.*
The president of IBM discusses the need for reinvigorating our educational system to meet the industrial challenge of the Soviet Union 323

**India's Engineering Education** *R. W. Atkinson*
A "guest professor" presents a first-hand account of the condition of technical education in modern India 325

***CONTENTS CONTINUED***

**THE COVER: In the Chicago, Ill., area, Commonwealth Edison Company has a new power station which is near completion. It is the Dresden Nuclear Power Station located some 50 miles southwest of the city. Story on page 367.**

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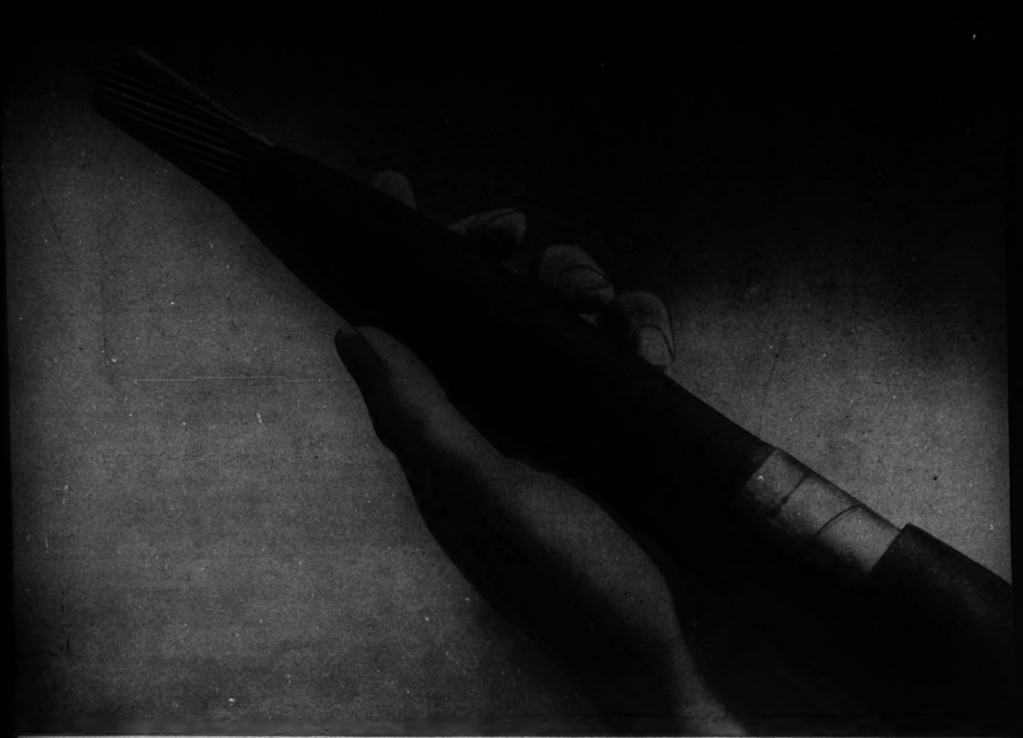

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# Contents Continued

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## Technical Paper Digests

Surge Measurement Errors of Coaxial Cables — *J. H. Park* 288
Overcurrent Protection in Shipboard Electrical Systems — *J. R. Cole* 293
The Insulator Contamination Problem — *J. E. Conner, A. D. Lantz, Jr.* 297
138-Kv Isolated-Phase Bus and Switching Structure — *R. H. Albright* 303
Telephone System Transmission Performance Objectives — *W. K. MacAdam* 307
Leakage-Flux Suppression in Magnetic Air Breakers — *A. P. Strom* 317

## Departments

Electrical Engineering Education 323
  AIEE in University of Dayton 323
  An Electrical Engineer in Industry 327
  Annual ACE Day Scheduled by OSU College of Engineering 328
  Summer Career Program Aids in Scientist Recruitment 329
  AEC–ASEE Summer Institutes on Nuclear Energy 332
  Plan for Increasing Number of Engineering Teachers 333
Institute Activities 335
  Washington, D. C., Will Again Be Host to AIEE Middle Eastern District Meeting 335
  AIEE Future Meetings 337
  Great Lakes District Meeting at Kellogg Center on Michigan State Campus 340
  1958 Winter General Meeting of AIEE Sets Record for Attendance 342
  Highlights of the February AIEE Board of Directors Meeting 346
  Formation of New Section Announced at AIEE Section Representatives Meeting 347
  Dr. Goldsmith Named Chairman of AIEE Member-Gifts Campaign for New Center 349
  Young Electrical Engineers Honored at Eta Kappa Nu Awards Dinner 352
  East Central District Meeting Will Be Held in Huntington, W. Va. 353
  Report of Nominees for Institute Offices 354
  National Telemetering Conference, June 2-4, 1958 357
  AIEE Personalities 360
  Obituaries 364
Of Current Interest 365
  Radar Information Is Converted to Television Signal 365
  Phosphor Coated Transparent Tube Developed 366
  Future Meetings of Other Societies 367
  Electron Tube Works After Explosion 369
  Transparent Magnetic Oxides 371
  Portable Completely Automatic Film Developer 373
  U. S. and British Controlled-Fusion Research 374
  Mystery Man Needs Identification 377
  Space Sentry Aids Explorer Satellite Tracking 378
  Letters to the Editor 379
  New Books 380
  Technical Literature 381
Industrial Notes 18A
New Products 50A
Trade Literature 56A
Index to Advertisers 86A

Statements and opinions given in articles appearing in *ELECTRICAL ENGINEERING* are expressions of contributors, for which the Institute assumes no responsibility. Correspondence is invited on controversial matters. Published monthly by the

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
Founded 1884
Headquarters, 10th floor • Editorial Offices, 6th floor
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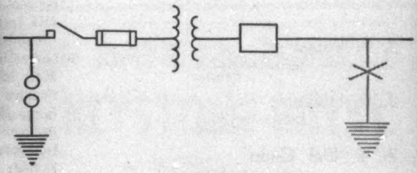
ELECTRICAL ENGINEERING. Published monthly by the American Institute of Electrical Engineers; publication office Hildreth Press, Bristol, Conn. Editorial and advertising offices 33 West 39th Street, New York 18, N. Y. Member subscription $6 per year nondeductible from dues: single copy 75 cents. Nonmember subscription $12 per year plus extra postage to all countries to which second-class postage rate does not apply; single copy $1.50. Entered as second-class matter at the Post Office, Bristol, Conn., under the Act of Congress of March 3, 1879. Accepted for mailing at special postage rates provided for in Section 538, P. L. & R. Act of February 28, 1925. April 1958. Vol. 77, No. 4. Number of copies this issue, 67,000.

# Can a primary power fuse "see" line-to-ground secondary faults?...



[illegible] the data illustrated are for self-cooled transformers, similar tables are [illegible] air-cooled transformers.)

**POWER TRANSFORMERS**

*TABLE 3 Minimum Ampere Ratings for the Primary Fusing of Three-Phase or Banks of Three Single-Phase Self-Cooled or Water-Cooled Power Transformers

| Nominal → System Kv | 23 | | 27.6 | | 34.5 | | 46 | | 69 | | 115 | | 138 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Transformer 3-Phase Kva ↓ | Full Load Current (Amps) | Fuse Unit Rating (Amps) | Full Load Current (Amps) | Fuse Unit Rating (Amps) | Full Load Current (Amps) | Fuse Unit Rating (Amps) | Full Load Current (Amps) | Fuse Unit Rating (Amps) | Full Load Current (Amps) | Fuse Unit Rating (Amps) | Full Load Current (Amps) | Fuse Unit Rating (Amps) | Full Load Current (Amps) | Fuse Unit Rating (Amps) |
| 1000 | 25.1 | 40E | 21 | 30E | 16.7 | 25E | | | | | | | | |
| 1500 | 37.7 | 50E | 31.4 | 50E | 25.1 | 40E | 18.9 | 25E | 12.5 | 20E | 7.6 | 10E | 6.3 | 10E |
| 2000 | 50.3 | 65E | 41.8 | 65E | 33.5 | 50E | 25 | 40E | 16.8 | 25E | 10 | 13E | 8.4 | 13E |
| 2500 | 62.8 | 100E | 52.5 | 80E | 42 | 65E | 31.5 | 50E | 21 | 30E | 12.5 | 20E | 10.5 | 15E |
| 3750 | 94.3 | 125E | 78.5 | 125E | 63 | 100E | 47 | 65E | 31.5 | 50E | 19 | 25E | 15.7 | 25E |
| 5000 | 126 | 175E | 105 | 150E | 84 | 125E | 63 | 100E | 42 | 65E | 25 | 40E | 21 | 30E |
| 7500 | 188 | 250E | 157 | 250E | 126 | 175E | 94 | 125E | 63 | 100E | 37.5 | 50E | 31.4 | 50E |
| 10 000 | 252 | 400* | 210 | 300E | 167 | 250E | 126 | 175E | 84 | 125E | 50 | 65E | 42 | 65E |
| 15 000 | 376 | 600* | 314 | 500* | 252 | 400* | 189 | 250E | 125 | 175E | 76 | 100E | 63 | 100E |

*Use two fuse units in parallel, each having an ampere rating half of the listed ratings.

# Science and Technology in a Changing Environment

E. W. ENGSTROM
FELLOW AIEE

**At the Eta Kappa Nu Award dinner, Dr. Engstrom pointed up the need for a long-range training program, rather than a crash program, for supplying our national scientist-engineer needs.**

I AM HONORED to be invited to join you this evening in paying tribute to three young men as outstanding representatives of the engineering profession. Their professional achievements have earned our admiration and our gratitude. They have likewise earned it for the extent to which they have applied their talents beyond their professions to the benefit of the communities in which they live.

The Eta Kappa Nu Association also deserves congratulation for extending public recognition to these young men and, by implication, to our younger generation of engineers. An essential inducement to any young man or woman in selecting a career is the assurance that it offers both challenge and reward. And reward must include recognition of outstanding accomplishment. In this sense, this occasion provides a needed example in engineering. It is a timely example, for only lately do we—as a nation—seem to have become aware of the critical importance of attracting young people in greater numbers into scientific and engineering careers.

### PRESENT EMERGENCY

THE SITUATION has been brought forcibly to our attention because of the emergency related to defense needs. This emergency is a real one. But we must not content ourselves by thinking that the sole reason for seeking now to increase our supply of trained scientists and engineers is to provide military security.

The truth is that we are in a situation which is broadly fundamental in nature. Its roots are the rapid technological progress of our society and the increasing demands of a growing population. These factors together create a long-range need for scientists and engineers in ever-greater numbers. They are needed to provide the expanded technological base for advancing our living standards in the future. The need is one which would press urgently upon us regardless of any threat posed by Soviet technological accomplishments. The need is basic to our growth and progress in commerce and industry, as well as military security.

My purpose tonight is not to dwell specifically upon the present emergency in the area of defense technology. I feel that our reservoir of scientific and engineering talent is sufficient to meet this need, given proper direction and wise utilization. My concern is rather with the more urgent problem which began more than a decade ago and the principal requirement of which lies a decade or more in the future. Let us examine briefly the nature and origins of this long-range problem. I propose to emphasize the challenge and opportunity which it presents to those who have just chosen and who will choose in the future to make their careers in science and engineering.

### THE VITAL ENGINEER

THE PROBLEM, the challenge, and the opportunity all stem from the incredibly rapid and accelerating pace at which modern technology has developed and is continuing to develop today. It is only within the past 100 years that the professionally trained engineer has become a vital factor in the American industrial scene. It is only within the past 50 years that the research scientist and the research laboratory have become closely associated with industrial activity. The organization of the scientist–engineer team that is responsible today for the speed of our technological development is almost entirely a product of the last several decades.

Up to about 100 years ago, empiricism rather than science was the order of the day. Industrial development depended largely upon mechanical inventiveness. Research men in universities were beginning to lay the foundation stones of modern science, but they were doing so in total isolation from industry. With the appearance of the trained engineer in industry after 1850, the way was opened for the more extensive practical application of scientific results.

With the turn of the century came a remarkable forward surge in the physical sciences. The decade between 1895 and 1905 brought, for example, the discovery of X rays, radium, and the electron, and the development

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E. W. Engstrom is senior executive vice-president and director of Radio Corporation of America, New York, N. Y.

of the quantum theory and the theory of relativity. In a real sense, this was the beginning period for modern science as we know it today. These and other discoveries, together with the increasingly important role of the engineer, added a new complexity and scope to technology as a whole. One result was a beginning of an association of scientists with industry in slowly increasing numbers. This was the birth of industrial research.

### SCIENCE AND INDUSTRY

The entry of science into the industrial scene occurred after the place of the engineer had become well established. Soon, working relationships were developed between scientists and engineers. This led inevitably to the organization of the scientist–engineer team incorporating the specialized talents needed to cope with an increasingly complex technology. Just as inevitably, the evolution of the team was accompanied by the gradual disappearance of the old-fashioned inventor, whose aptitude and intuition were unfortified by any extensive knowledge of science. Inventiveness, rather than being individually conspicuous in the old way, now came to seek an outlet through the group representing diverse specialized skills and knowledge. Thus, while the independent inventor all but vanished, invention itself moved into a setting and atmosphere of science, an environment planned for and highly conducive to creativity.

**TEAM STUDY** of radiation effects on various electronically active materials at RCA Laboratories is carried out with this Van de Graaff particle generator which is being prepared for operation by members of the RCA Laboratories research team.

Today, the research scientist and engineer work in full partnership within industry. Furthermore, the old divisions between industrial technology and university research have been leveled. The result has been to speed the practical applications of science. Before the turn of the century, the scientist who formulated a new theory rarely lived to see the utility of his idea. Today, theorists, scientists, and development engineers work together in the research team. This team is capable of formulating a concept and carrying it to practical application within a relatively short time.

### THE TEAM

The growth of the scientist–engineer team is distinctly a 20th-Century phenomenon. It forms one aspect of the changed and broadening environment in which ever-greater opportunities and challenges await the young engineer today. In this changing environment, the task of the engineer has itself become increasingly complex and demanding of higher skills. This is the consequence of our growing reliance upon large and complex systems as opposed to isolated devices. With the trend toward complete systems to perform specific functions in industry and defense, the widespread practice of systems engineering has grown up.

The concept of systems engineering has been with us for a century or more. Only within the past two or three decades, however, have we come to recognize it as a discipline in its own right. It is ideally suited to the solution of difficult problems raised by today's complex undertakings. Using the systems approach in any given project, first the objective to be reached is determined. Then all factors that bear upon the possibility of reaching that objective are thoroughly considered, and the relationships among these factors are weighed. Clearly, this approach to complex technological objectives cuts across the boundaries among the various academic disciplines. It calls for full teamwork among individuals of many specialized skills ranging from physics to mechanical design. It is a function, in other words, of the scientist–engineer team.

The practice of systems engineering imposes a set of standards and procedures that have universal application in our technology. These include careful definition of objectives, full co-operation at all stages of a project and an ability to compromise on details for the sake of reaching the main objective. These characteristics apply not only to the development of large systems, but also to many of our research projects.

The young scientist or engineer entering a career today functions from the start in an environment in which these standards and procedures are becoming firmly established. As a result, he should feel greater assurance than ever before that his skills will be utilized and directed toward the principal objectives most effectively.

### ACCELERATING PRESSURES

Concentration upon main objectives is an urgent necessity in the circumstances that surround us today in technology. With research and development accelerating at a tremendous rate, ever-greater pressure is being exerted upon the scientist and engineer to produce results.

The pattern of this acceleration was shaped largely during World War II. To generate and maintain an abundant flow of new ideas and equipment, the Government poured unprecedented funds into research and development by industry, by universities, and by Government and private laboratories. The result was the pattern in which we are living today. Organizations that had engaged in research in prewar years expanded their activities. Other organizations were drawn for the first time into research. New enterprises were started the sole business of which was research under Government contract. Military demand, continuing after the war and through the Korean conflict, encouraged further growth in all of these areas.

With this phenomenal expansion of research and development came a clear-cut need to shorten the lead time between science and technology, and between technology and hardware. This need, together with the large-scale physical expansion of research and engineering facilities, introduced competition for the first time on a large scale into research and development. This competition became marked not only in the military area, but in areas of commercial activity as well.

This over-all quickening of pace is a self-perpetuating process, nourished simultaneously by the various competitive pressures, and by the swiftly rising level of our technology. Furthermore, we are hurrying it along with the intensified program now being undertaken in response to Soviet Union advances in missile technology. With this intensification, there will surely come new pressures for swift results.

Under these conditions, large numbers of new technical developments will make their appearance simultaneously. Research and development groups of independent organizations, simultaneously active in the same field, are pressed to move quickly in order to retain the competitive advantage of time.

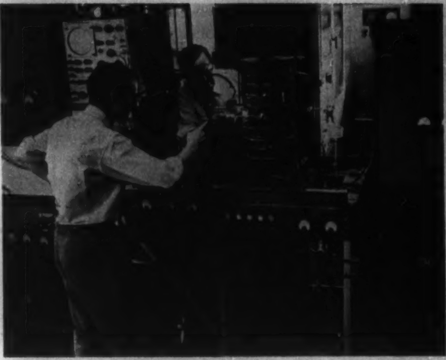
On the surface, an ideal environment exists for the young scientist or the young engineer. Certainly it offers an ideal proving ground for his abilities, incorporating a degree of opportunity and challenge unmatched at any time in the past. At the same time, conditions of this environment impose new responsibilities both upon present and future generations of technically trained personnel, and upon the society that looks to them for the essential continuation of our technological progress.

### OVERDUE RECOGNITION

RECENT EVENTS indicate that we are giving long-overdue public recognition to the fact that our outlook in technology is a matter of national concern. It is unfortunate, but natural, that this general recognition has dawned largely because of the threat posed by the Soviet scientific accomplishments. As a result, we may too easily be tempted to accept short-term emergency measures as a substitute for the less dramatic steps that must be taken to expand our entire technological base through the years ahead.

One of these steps is the reconstitution of our basic research effort and its maintenance at an adequate level in the future. Another is the creation of a public understanding in which the vital role of technology is appreciated by all United States citizens, specialist and nonspecialist alike. Let us examine these requirements in greater detail.

Because of the very rapid acceleration of technical progress and the ever-increasing pressure for practical results, we have been using up existing fundamental scientific knowledge in several areas more rapidly than new knowledge is being accumulated. To remedy the deficiency, large-scale basic research effort is required. In order to meet the demand, however, basic research must be relieved of many current pressures, and particularly of those pressures for the delivery of hardware at the earliest possible moment.



**TEAM MEMBERS** study superhigh current density electron beams for new microwave and millimeterwave techniques, for radar and other specialized applications, with this complex equipment developed at RCA's David Sarnoff Research Center, Princeton, N. J.

We are supplied today with the talents for basic research. They are to be found in universities and in the laboratories of Government, foundations, and industry. The requirement today is to be sure of the best utilization of all available talent—to bring about some measure of co-ordination to assure proper coverage of the new frontiers, to provide continuity and long-term support, and to sustain a steady growth in effort.

### FOUNDATIONS OF KNOWLEDGE

THE PRINCIPAL SOURCES of fundamental scientific knowledge have long been our colleges and universities. In the years during and since World War II, however, the role of these institutions has undergone a marked change. The growing complexity of research facilities and programs has increased the cost of research and created the need for larger teams of scientists. For educational institutions, the costs of scientific exploration have become too great to be met by endowment and other traditional means of support. Yet, these institutions have had to continue research because of military requirements, because of graduate student training, because of faculty desires, and because of competition. Under these circumstances, the institutions have turned increasingly to activities for which financial support is most readily available and relatively certain to continue —that is to say, applied research and development under military sponsorship.

As a result of this trend, colleges and universities today have become users as well as creators of new knowledge, adding to the process of depletion. This is rather as though a mother bird, bringing food to her fledglings, crowded into the nest with them to eat it. It is no longer possible, as it once was, to measure our basic research effort by measuring the volume of scientific research in educational institutions. Their well-being with respect to research has become too tightly bound to the fortunes of the military programs.

**RESEARCH TEAM** conducts work on experimental microminiature decoding device at RCA's David Sarnoff Research Center, Princeton, N. J.

To be sure, a part of the deficiency is met by the development of basic research programs in industrial laboratories. These programs have evolved not simply because there is an obligation to add to the store of new knowledge, but also because of the realization that a balanced amount of basic research is conducive to greater effectiveness and more rapid progress in applied research areas. But the addition of these industry sources still is not enough today to feed our accelerating technology. Relatively few industrial laboratories conduct uncommitted basic research. For industry as a whole, there remains a large imbalance between basic and applied programs. Industry can and should seek to achieve a better balance. Industry should continue the expanding pattern of support for uncommitted basic research and for fellowship aid in graduate training at educational institutions.

### NEEDS OF A NATION

Present and future needs for basic research cannot be met by such means alone, however. These are national needs and meeting them is a matter of long-term national concern. We are justified, therefore, in thinking of basic research as a matter of public policy now and in the future.

With the continuing international tensions and the growing rivalry for military supremacy, it is natural that the military departments should sponsor basic research. Except for the field of atomic energy, Government aid has come largely from the military departments. It is right and proper that the military departments should sponsor basic research. It is my conviction, however, that basic research in educational institutions, especially, should not be as dependent upon the programs of the military as it is today. Also, in the long run, it is questionable whether such military sponsorship in general should predominate to the extent that it does today.

The Congress has established an appropriate mechanism for sponsoring research through the National Science Foundation. Here is the organization which is in a position to assess the needs of our country for basic research. The task of the Foundation should be to assure the needed effort in basic research, to assure the flow of new knowledge, and to assure the supply of trained scientists.

There has been a steady increase in funding for the National Science Foundation since 1951. However, its operating budget has been most modest when considered in relation to our long-range need for the services of the Foundation. This year, the proposed budget calls for a threefold increase in National Science Foundation funds. This unquestionably is a right step in the right direction. However, the provision for the support of basic research is, in my opinion, still on the low side. What is now necessary is full recognition of the fact that the Foundation should pay an increasingly important role in the years to come. To fulfill this function, it must, for one thing, be assured of adequate funding to meet the challenge before our nation.

### PUBLIC APPRECIATION

Provision of an adequate source of new basic knowledge will assure a firm base for technological progress tomorrow. A second requirement, previously mentioned, is the creation of public understanding and appreciation of our reliance upon technology for continued national well-being.

Many thoughtful proposals are being offered today to implement the improvement of science education in our public schools. Many steps are being initiated or contemplated to raise the quality level of science teaching and to provide extensive scholarship aid for students in the sciences. The objective of these measures is to equip more young people with the desire, the ability, and the opportunity to enter careers in science and engineering.

The long-term need for high quality and greater quantity in technically trained personnel is beyond question in view of our population growth and the continued acceleration of our technology. So many possible methods of achieving this increase in personnel have been suggested that there is little point here in attempting to summarize them or to add yet another proposal.

However, it should be emphasized that all of these proposals involve a further requirement. This requirement is for full public understanding as to just what must be done and why. It is becoming evident that today there is a general comprehension of the present threat in the military sense. It is far less evident that there is sufficient understanding of the danger that we may fail to provide an adequate base for our technological progress in the years ahead.

### CO-OPERATION AND COMPETENCE

In this situation, there is more urgent need than ever before for full communication between scientist and layman. Both must participate in the definition of objectives. Both must co-operate in the effort that is required in carrying forward the basic research programs and educational measures that will meet the needs for tomorrow. No effective solutions can be found by an isolated professional group on the one hand, or an uninformed or uninterested public on the other. The formulation of long-term policies in research and education calls for leadership on the part of all who understand the nature and the urgency of the task.

For the scientist and the engineer, the situation calls not only for professional competence, but also for an appreciation of the political, social, and economic environment in which he functions. The qualities that are required have been demonstrated by the young men whom we honor here tonight, and by the encouraging number of nominees from among whom they were selected. They have, in common, the experience of leadership in the affairs of their communities. Today, we rightly regard them as outstanding representatives of their profession. But the attributes for which we honor them must be the rule among the new and coming generations of technical people.

For the man of Government, for the man of commerce, for the man of industry, and for people everywhere, there must be a growing awareness of science and what science is producing. There must be an understanding of our environment, our nation, our world, in terms of what science provides. There must be understanding that geography in terms of time and distance is gone forever. We are exploding into the "space age."

For the leaders of tomorrow there must be appreciation, knowledge and training in science. For how can a man lead unless he understands with some depth just what forces motivate and move in our world of today and tomorrow? We have for long heard the cry that scientists and engineers need training and experience in the humanities. This is so. Today we hear the cry that emphasis on science should not be allowed to push the humanities into the background. This, too, is so. But now these are only half-truths. Now the nonscientists need training and experience in science. Today's tasks and, even more, tomorrow's tasks require and demand the whole man.

### THE TRUE GOLDEN AGE

The years ahead hold a brilliant promise if we organize now to co-ordinate all of our talents in meeting the objectives that I have mentioned. New sources of power, increasing automation, new basic materials, and new techniques of communication can form the technological base for a growing as well as increasingly prosperous and better society. But it is here and now that the foundations must be laid. We should not be diverted from this whole task by the unquestioned need for meeting just a military threat today. Exclusive preoccupation with the technology of missiles, satellites, and other systems of military significance may equip us with a most effective defense, only to leave us tomorrow with far less that is worth defending. Yet, today we are in an emergency situation and the defense effort must come first and with full measure. At the same time, we must keep our eyes trained on the goal not only of defense, but also of freedom and the well-being of mankind.

Science is providing the means for a golden age if the results are directed toward the benefit of mankind. At the same time, science is providing the means for utter destruction, if the results are directed toward selfish, greedy, and depraved ends. History shows that mankind has traveled an uncomfortable pathway, buffeted between extremes of good and evil. What is different now, however, is that the tools for destruction are becoming concentrated and all-powerful. History, likewise, shows man to be remarkably adaptable when confronted with new situations, new conditions, new relationships, and given adequate time to react and change. Now, however, these changes come with ever-increasing speed and of ever-greater magnitude.

It is important that man's relationships with man be right. But it is all-important that man's relationships with his Creator and God be right. It is here that solutions are to be had. But this requires that we direct our purposes in order to be in tune with His purposes for us.

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| N. I. Hall | 1943 |
| R. W. Porter | 1944 |
| J. M. Wallace | 1945 |
| E. M. Williams | 1946 |
| R. R. Hough | 1947 |
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# Surge Measurement Errors of Coaxial Cables

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MEMBER AIEE

NEARLY ALL surge or impulse voltage measurements involve the use of a cathode ray oscillograph (CRO) and measuring cable. All cables have a certain amount of attenuation and their surge impedance is never the same for all frequencies as indicated in several studies. In low-voltage impulse work (where very short cables can be used) such factors may be negligible under certain conditions, but for measuring high-voltage surges, a fairly long cable (50 feet or longer) is usually required and possible errors caused by the cable should be considered, especially for measuring steeply rising surges. The purpose of this paper is to discuss such errors and devise method for measuring and minimizing them.

The attenuation of coaxial cables is usually expressed in decibels per 100 feet at a fixed frequency and although values of attenuation for the entire frequency spectrum are known, it would be difficult to use such information for computing the error caused by attenuation when measuring the peak value of a voltage surge. An experimental approach is easier to apply and probably more reliable. One such approach, using linearly rising voltage surges chopped with a sphere gap, was applied to two types of polyethylene insulated cable. Results are shown in Fig. 1 for *RG-58/U* and *RG-8/U* coaxial cables .

A change in cable surge impedance with frequency is introduced by (1) the cable resistance and conductance which put a "jω" term in the impedance and (2) the change in cable inductance and resistance caused by skin effect. Measurements made by W. R. Thurston which were published in the May 1957 *General Radio Experimenter* under the title "The Measurement of Cable Characteristics" indicate that for 50-ohm polyethylene cables, this change may be as much as five ohms while going from low to very high frequency. Thus, surges with different rates of rise would require cable terminations of different resistance to prevent errors caused by reflections. However, experimental results indicated that reflection errors for all types of surges can be eliminated by terminating the CRO measuring cable with another length of the same type of cable with a resistor of the proper value at its end.

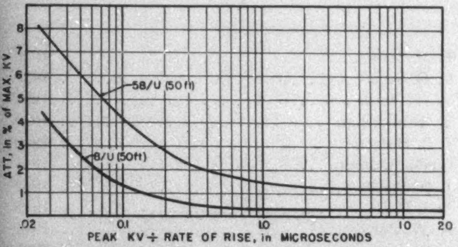

Fig. 1. Attenuation of linearly rising chopped surges by *RG-58/U* and *RG-8/U* coaxial cables.

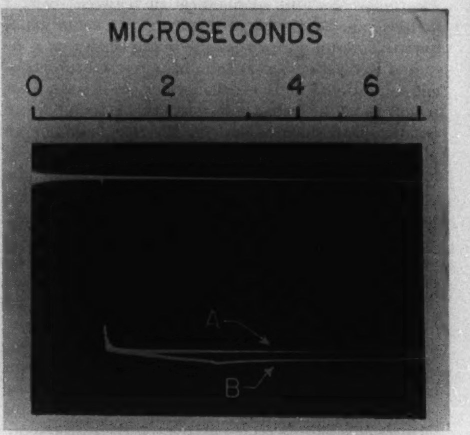

Fig. 2. Oscillograms showing effect of resistance of *RG-58/U* terminating cable when measuring the voltage across a 50-ohm divider low side.

The effect of the resistance of the terminating cable was investigated analytically and experimentally. Under some conditions, this resistance introduces a large error as shown by Fig. 2. In the figure trace "A" is obtained with a 3-foot terminating cable; trace "B" is obtained with a 500-foot terminating cable. However, by using a polyethylene insulated cable such as *RG-8/U* or one with larger diameter, such errors can usually be made negligible.

Experimental results obtained using terminating cables of various lengths indicate that a fixed noninductive terminating resistor with no terminating cable may be used to measure the peak value of surges with an accuracy of 1% when their rise time (time to chopping) is greater than 0.2 microsecond. To measure surges with rise times of 0.2 microseconds or less, a terminating cable about 100 feet long should be used between the CRO and the terminating resistor.

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Digest of paper 58-110, "Surge Measurement Errors Introduced by Coaxial Cables," recommended by the AIEE Special Instruments and Auxiliary Apparatus Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Winter General Meeting, New York, N. Y., Feb. 2-7, 1958. Scheduled for publication in AIEE *Communication and Electronics*, 1958.

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# Entering the Machine Domain

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**Every means possible should be employed to avoid the unnecessary use of human activity in high-speed electronic computing operations. Certain aspects of experimental psychology appropriate to entering the machine domain are discussed.**

INCREASED INTEREST in the human-to-machine information transfer problem stems from the inequality between human and machine accuracies. In the machine domain, there are essentially no errors (probably less than one mistake in $10^{20}$ digits transferred), but, in the human domain the error frequency is of the order of one mistake in about 200 digits transferred.

In a way, it seems absurd to put into the machine domain raw data having a 1% error (or greater) when within the machine domain the error frequency is something like 20 orders of magnitude smaller. Consequently, it seems desirable to pay some attention to the problems of entering the machine domain so that accuracy of data fed to the machines can be improved.

In order that we may appreciate the nature of the problems involved, and in order to discover some ways in which to transfer better, the following discussion is developed, centered around certain aspects of experimental psychology and around information theory.

## ELEMENTARY CONCEPTS

*Perception.* Consider an operating system having as a part of it the supply of spare parts to a field activity. Assume that a man in the field party needs a certain replacement part. Before anything can happen, the field man needs to perceive the part which he wants. He may perceive it by holding it in his hand and viewing it with his visual apparatus. He may also look in a catalog and use a word description or a picture to give him some idea of the thing in mechanical form or in symbolic representation. At this stage in the process, the emphasis is on perception; that is to say, man receives some sort of energy in visual, aural, tactile, or other form, which stimulates him to try to recognize this thing which he wants.

*Recognition.* The matter of recognition is complex, the field man's mind is stimulated and begins to function in terms of past experience and in terms of logical processes, and eventually he recognizes the thing which he wants. Recognition involves a visualization and an understanding of the thing, of its uses, its functions, and its relationships to other things.

*Native-Language Concept.* Following his recognition of the thing, a native-language concept must be formed to permit him to recall the thing at some later time. Very probably, this native-language concept is in the form of a mental image of picture-like nature as well as in the form of a word symbolism. There has now occurred *perception, recognition,* and formation of *native-language* concept. Each of these areas has potential error sources so there may be an accumulation of error up to this stage.

*Transmission.* In order to obtain the thing needed, the field man must make his requirements known to someone who can supply him with the part. He could speak these things which have generated themselves in his mind, or he could make ordered marks on a piece of paper using his native-language concept in symbolic form, or otherwise convey a message.

Here a difficulty arises because of the difference between native-language concepts of specific individuals. That is, each person has a peculiar native-language concept and symbolism, associated mental pictures, personal experiences, and so on. There is usually a detectable difference between native-language concepts. As an example illustrative of this, consider the sender speaking only English while the receiver speaks only French.

*Reception.* The person receiving the message is stimulated by sounds reaching his ear, or by impulses sensed by his eyes, or otherwise, and perception takes place. As before, the receiver must recognize, and finally develop his native-language concept of the thing under discussion.

If these processes occur accurately, then the receiver will have an exact replica of the intent of the sender. But to this point there are at least six potential error sources, all in the human domain.

*Complete Cycle.* In practice, of course, things may be a little more complicated. Consider the following set of circumstances: The field man is a Frenchman who speaks English with an accent (in addition, the poor fellow has a tendency to stammer). At the receiving end, there is an Irishman with a high-frequency hearing loss. The man in the field wants 47 Woodruff keys. After an elaborate telephone conversation in which understanding seems to be complete, the man

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Full text of conference paper 58-36, presented at the AIEE Winter General Meeting, New York, N. Y., Feb. 2-7, 1958, at a session sponsored by the AIEE Communication Theory Committee.

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in the field is surprised to receive a key to the company offices at 47 Woodrow Street. The machine domain was working perfectly, but errors in the human domain were large.

### DIGIT SPAN

IF THE FIELD MAN is considered to be a communication channel, that is, a transfer mechanism between stimuli which he receives and the transfer of this information in common-language form, then to use the suggestion of Miller,[1] this relationship may be illustrated as shown in Fig. 1.

This is a useful concept, in terms of information theory. It appears that a person is, in a sense, a communication channel for the moving of information from some elementary form through a translation process to a common-language form—a symbolism.

It seems worthwhile here to examine the standpoint of psychology and the standpoint of information theory with respect to a "bit" of information. Miller expresses it in this way: a bit of information is that amount of information necessary to make a decision between two equally likely alternatives. If it must be decided, for example, whether a bolt is more or less than 2 inches long, then one bit of information is needed to make this decision. This unit of information does not refer in any way to the length of the bolt per se, but only to the decision as to whether or not the bolt is longer than 2 inches. Two bits of information allow a decision to be made between four equally likely alternatives, three bits between eight equally likely alternatives, and so on.

If we are concerned with ways in which the amount of input information may be increased, then perhaps an increase in the rate of input could be achieved; or, if the time variable can be ignored, then the amount of input information could be increased by showing a number of alternate stimuli. The general problem of rate of transfer, in this instance of rate of input, is one of the facets of the problem. However, the most important at the moment seems to be accuracy of transfer. Speed and accuracy are not disconnected, however, and in emergency situations the time taken to transfer information cannot be infinitely long.

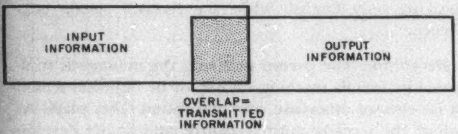

**Fig. 1. Human communication channel.**

Ordinarily, a stock number in a catalog is a series of digits and, therefore, might be considered a unidimensional stimulus. With such a unidimensional system, it has been determined by experiment that the capacity of a human being lies between two and three bits. The accuracy with which a human can comprehend and transmit information in unidimensional form begins to decline sharply at about the 2.5 bit level. This corresponds to accurate choice between about six equally likely alternatives.

Quoting Miller: "We must have some understanding of why the one-dimensional variables we judge in the laboratory give results so far out of line with what we do constantly in our behavior outside the laboratory. A possible explanation lies in the number of independently variable attributes of the stimuli that are being judged. Objects, faces, words, and the like, differ from one another in a number of ways, whereas the simple stimuli considered in the earlier example differ from one another in only one respect."

Klemmer and Frick[2] have done some experimental work on the absolute judgment of the position of a dot in a square. Under these conditions, the human channel capacity is shown to be about 4.6 bits, which means that people can identify accurately any one of 24 positions in the square. This is in the domain of two-dimensional stimuli.

Pollack and Fricks[3] tried an experiment in which they used six different acoustical variables that they could change, frequency, intensity, rate of interruption, on-time fraction, total duration, and spatial location. Each of these six variables could assume any one of five different values. Thus there were $5^6$ tones that could be represented. The listeners made a separate rating for each of the six dimensions. Under these conditions, the transmitted information was found to be 7.2 bits, which corresponds to about 150 different categories which could be absolutely identified without error.

It seems, therefore, that in arranging catalogs and stock numbers for field men, the capacity of the individual to perform in this domain may be increased by attention to the concept of multidimensional stimuli.

In transmitting, after the stimulus has been received, it must be recognized that there is a limitation speechwise to about eight or nine distinctive features. These occur in every language that has been studied. Therefore, some tricks must be used in order to increase the channel capacity. For example, a complex word may be used to stand for an extensive and complex thought. This is in the nature of recoding, or condensation. Miller emphasizes the idea of a limit on the span of absolute judgment and maintains that for unidimensional judgments, this span is of the order of seven. He goes on to say, "We are not completely at the mercy of this limited span, however, because we have a variety of techniques for getting around it and increasing the accuracy of our judgments. The three most important of these devices are:

a. To make relative rather than absolute judgments, or if that is not possible
b. To increase the number of dimensions along which the stimuli can differ, or
c. To arrange the tasks in such a way that we make a sequence of several absolute judgments in a row."

One needs to draw a distinction between the span of absolute judgment and the span of immediate memory. These are quite different kinds of limitations. Immediate memory falls in the category of being limited by the number of items. Miller introduces the concept of "chunks" of information and he points out that the number of bits of information is constant for absolute judgment and the number of chunks of information is constant for immediate memory. The span of immediate memory seems to be almost independent of the number of bits per chunk over the range which has been examined experimentally. It has been observed that persons can repeat back eight decimal digits but only nine binary digits. This is an interesting experimental fact and, without doubt, involves a recoding process.

In this connection, it is worth noticing that the very extensive Federal Stock number contains 11 digits, which when written in continuous sequence lies outside the span of humans. When, however, the 11 digits are broken into a 4-3-4 sequence, each of the groups does lie within human capacity. This corresponds to Miller's third category, namely, arranging tasks in sequence.

Miller makes a very succinct summary of the problems of absolute judgment and the span of immediate memory, and points out that both immediate memory and span of absolute judgment impose severe limitations on the amount of information that a human is able to receive, to process, and to remember. But by organizing the stimulus inputs simultaneously into several dimensions, and successively into a sequence of chunks, there is a possibility of extending the ability of the human being. Also, the process of recoding is important in human psychology and seems to deserve more attention than it has received. The kind of linguistic recoding that people do seems quite essential to the thought processes. Recoding procedures are a constant concern of those interested in the fields of psychology, anthropology, and linguistics. In addition, the concepts and measures provided by information theory give quantitative ways of getting at some of the questions raised by the foregoing considerations. These theories of information give us the ability to calibrate and to measure the stimulus materials and in addition they are useful tools for measuring the performance of individuals.

### VISUAL PERCEPTION

**Paul Schilder**, as translated by David Rapaport, gives some interesting observations in the field of visual perception.[4] He points out that human vision is quite sensitive in the peripheral region of the visual field. Once attention is focused on an attractive movement in the periphery and intensive scrutiny takes place, interest wanes and the peripheral sensitivity overrides central attention. That is to say, as soon as attention is focused on the object the mechanisms of the eye and of the brain begin to lose interest and it becomes increasingly difficult to maintain attention. This process is repeated over and over.

In terms of examining a stock number in a catalog, it may be worthwhile to think of ways in which visual perception may be aided perhaps through increasing and decreasing size of successive numbers, perhaps by surrounding a small number with a large one, and in similar ways, in order to take advantage of the natural processes of visual perception.

The problem of Gestalt certainly comes into the picture. Thus, a person will usually see the several objects in a group and compose additional configurations from these smaller objects and their arrangement. For example, envision a square composed of 3 by 3 dots, with the entire ensemble within the field of vision. Upon looking at this configuration, the eye and the brain will compose vertical and diagonal crosses, giving rise to Gestalten of usual form. Certainly advantage should be taken of these tricks that the eye plays on the brain, and vice versa, in the composition of such things as stock numbers and catalog descriptions. This will aid the eye in making a more accurate use of information coming to it and, thus, assist in entering the machine domain with greater accuracy.

Returning to the earlier discussion of memory span, and the recoding process, this square of 3 by 3 dots (equal to nine dots) is beyond the human capacity to determine the number of dots present. However, application of the problem of Gestalt, that of recoding, and other dodges, will permit the square to be reconstituted through appreciation of the 3 by 3 memory, and the subsequent counting of the actual number of dots present. Schilder observes that Gestalt perception comes about much in the same manner as perception in general. It would enter consciousness as a whole and would be based simply upon a psychological addition to perception. According to Froebes,[5] Gestalt adds a unification to the complex of sensations which is perceptual and must not be mistaken for an abstract understanding of relations. This perceptual apprehension is co-determined by sequence, emphasis, and grouping.

In this general area, psychic blindness must be considered. This is not ordinarily examined with respect to individuals concerned with transferring information from the human to the machine domain; however, it may play a more important role than suspected. For example, a study was made of the quantities of things ordered by several classes of persons. In ordering things, medical people had different preferred quantities than did engineers, these two classes differed from chemists, and the latter from mathematicians, and so on. Therefore, it is evident that preconceived "sets," or habitual tendencies in people, exist. This may be treated as a form of psychic blindness which may well confuse a sensitive industrial system.

There are perceptual forms of psychic blindness. To quote from Schilder: "In these cases Gestalten are perceived but the patient cannot make use of their visual impressions, even though their visual acuity and visual fields are adequate."

In general, the field of medical psychology and especially the visual, aural, and tactile perception needs to be examined with respect to the problem of moving from the human into the machine domain. It is believed that there may be aids which can be devised that will take advantage of the innate characteristics of the human beings involved in such processes.

## RANGE OF STIMULI

It is to be noted that there are other types of stimuli, and that there are ranges and variations which may be termed multidimensional in aural, tactile, visual, and other senses. For example, size may be determined by feeling and by looking. Color is another factor in the description. Texture, weight, and resonant sound are other possible dimensions. The general shape of an object conveys information and, in addition, the object may have electrical properties, several degrees of freedom, and it may also have a smell and a taste. Thus, it seems desirable in transferring information involving the human being to use as many aids as possible to assure correct perception, recognition, and development of native-language concept with subsequent translation into common-language symbolism. The more dimensions used, the more accurate the description will be, and the more complex can be the object described.

In the acoustical field, experiments have demonstrated that a number of objects struck a ringing blow under standard conditions can be identified individually by the sound associated with them. The possibility exists, therefore, of entering the machine domain with an acoustical designation.

In the acoustical field, experiments have demonstrated that a number of objects struck a ringing blow unwriter numerals such that modern fonts show the 3 extending below the line, the 4 above, the 5 below, the 6 above, and so on. This gives an irregularity to number sequences of the nature of an additional dimension and unquestionably aids in identifying the numbers.

It has long been known in the advertising field that lower case advertising is easier to read and makes a better impression on the client than does all capitals with uniform upper and lower boundaries. If, to such two-dimensional forms, there were to be added color and weight associated with each number, then a four-dimensional position would be achieved which would add to the accuracy of processing. It is tricks and dodges of this sort which need to be employed in improving the accuracy of human action when entering the machine domain.

## MINIMIZING HUMAN OPERATIONS

As observed thus far in this discussion, the presence of humans in a system containing high-speed electronic computers and high-speed accurate communications is quite inhibiting. Every means possible should be employed to eliminate humans in the data-processing chain. This is especially true of such operations as leaving the machine domain to invoke human action and subsequently re-entering the machine with all or a part of the same information. Unfortunately, except in those rare instances where initial information is derived from analog or digital instruments, it is dependent upon humans to generate the input to the machine domain.

This is not to suggest that humans have no usefulness in future civilizations, for the human brain is a very powerful, rational instrument of, as yet, unknown capacity. It is clear, however, that to use such an unusual instrument as the human brain for trivial and routine operations is a waste of this resource. Man certainly should avail himself, at every turn, of aids such as machines, in order to allow more time for contemplation, moral judgments, exercise of advanced concepts, and the choosing of proper courses of action. The machine should be thought of as a tool to assist us in achieving our goals more quickly and accurately.

## CONCLUSIONS

The foregoing discussion and the experiences cited indicate the great importance of devising aids, and invoking tricks to permit humans to enter the machine domain with accuracy and skill. The primary means of accomplishing this end may well fall into the following areas:

1. Attention to the role played by perception, recognition, and generation of native-language concept.
2. Development of common-language concepts and symbolism, including specialized catalogs such as those of thoughts, places, time, and so on.
3. Recognition of natural digit span and span of immediate memory in arranging number and letter sequences.
4. Aids to visual and other forms of perception so that multidimensional stimuli are employed rather than unidimensional stimuli.
5. Minimizing human intervention and human links in a chain containing computers and communications systems.
6. Reserving to humans the unusual problems of judgment, moral and philosophical balances, and emphasizing these functions through use of advanced machines for trivial and routine operations.

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# Overcurrent Protection in Shipboard Electrical Systems

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AS SHIPBOARD POWER DEMANDS have increased, it has been necessary to install more and larger generators aboard ship. It has been found that the most reliable and flexible system can be attained by arranging the bus ties in such a manner that they form a closed loop if all bus tie circuit breakers were closed. This arrangement can result in potential fault currents well over the maximum interrupting capacity of the available circuit breakers if all generators were operated in parallel. Therefore, it is necessary that the ship's service power plant be split in such a manner at all times so that the fault current will be within the capacity of the circuit breakers. Interrupting capacity of the U. S. Navy's largest circuit breakers has been increased to 100,000 amperes. This rating determines maximum numbers of generators that can be operated in parallel. On ships with eight 1,500-kw generator sets, only three generators may be operated in parallel at one time. With three generators operating in parallel, the rms fault current for the first half cycle in the phase carrying the maximum asymmetrical current is 86,000 amperes at the generator distribution switchboard and 62,000 amperes at the load center switchboards.

One of the things that are strived for on United States naval ships is maximum continuity of service under fault conditions to be achieved by the selective operation of the various protective devices. Selective tripping is accomplished by means of a time delay in the circuit breakers that is inversely proportional to current. This time delay is in the order of cycles. The circuit breaker closest to the load may have an instantaneous trip. Each circuit breaker, as it appears in the system proceeding from the load, must then have a time current band that will prevent it from initiating a trip until the circuit breaker in the system next closer to the load has sufficient time to trip and clear the fault. Thus, no protective devices in the system except those feeding the load directly should have an instantaneous trip. If it is necessary to provide this instantaneous trip setting to trip in the magnitude of fault current that may be expected, selective tripping is abrogated. If protective devices do not have adequate short-time current-carrying capacity or interrupting capacity it may be necessary to provide this instantaneous trip. In the first case, this instantaneous trip is provided in the circuit breaker that has inadequate current rating. In the second case, this instantaneous trip is provided as back-up protection for the circuit breaker having inadequate interrupting capacity. In the large capacity systems discussed, it has been necessary to provide back-up protection for the molded case circuit breakers thus limiting the selective tripping.

With the development of the 100,000 ampere interrupting capacity and 100,000 ampere short-time current rating air circuit breaker (Navy type *ACB*) and the fused molded case circuit breaker, ships electric plants of larger capacity with distribution systems that have a greater degree of selective tripping are possible. The fused molded case circuit breaker is essentially the standard molded case circuit breaker (Navy type *AQB*) equipped with current limiting fuses. A single fuse blowing trips the circuit breaker on high fault currents and limits the current in the circuit breaker to a value that will not damage the circuit breaker. Thus, back-up protection is not required with these fused molded case circuit breakers.

The fused breaker eliminates the need for *ACB* circuit breakers on the load center switchgear that previously were provided for back-up protection for molded case circuit breakers. Fused molded case circuit breakers are connected directly to the load center switchgear bus. It is estimated that 35 type *ACB* circuit breakers have been eliminated on a large carrier with attendant savings in weight and cost.

Another contribution to weight and cost savings has been achieved in automatic bus transfer equipment. The standard Navy contactor type bus transfer has a short-time current rating of 20,000 amperes. Where maximum available maximum rms asymmetrical fault current at the point of application of these bus transfers is above 20,000 amperes, it has been necessary to provide bus transfers made up of electrically operated type *ACB* circuit breakers of adequate short-time current rating. It has been demonstrated in tests that the fuses in the fused circuit breaker effectively limit the current times time-fault currents ($I^2T$) that these contactor type bus transfers may be called upon to carry to a value well below the thermal capacity of the contactors. Thus, where in the past it has been required to feed power panels via special type *ACB* circuit breaker bus transfer equipment the contactor type bus transfer may be employed by using fused molded case circuit breakers in power panels.

The availability of the 100,000 ampere interrupting capacity open frame air circuit breaker with the 100,000 ampere short-time current rating permits the use of larger ship's service generator capacity at 450 volts. The availability of these circuit breakers and the fused molded case circuit breaker have resulted in a great degree of selective tripping in these power systems.

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Digest of paper 58-132, "Overcurrent Protection in Large Capacity Shipboard Electrical Systems," recommended by the AIEE Marine Transportation Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Winter General Meeting, New York, N. Y., Feb. 2-7, 1958. Scheduled for publication in AIEE *Applications and Industry*, 1958.

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# Precise Measurement and the Race for Technological Supremacy

A. V. ASTIN

**Technological progress can be reflected, fundamentally, by a country's level of competence in measurement techniques. The USSR's progress in this field is a challenge that, if ignored, could be instrumental in undermining world free-enterprise economy status. Thus, in the race for technological supremacy, the role of the U. S. National Bureau of Standards is vital.**

ALL PHYSICAL MEASUREMENTS yield results in the form of numbers whether the measurements are made in scientific laboratories, in industrial plants, or in the exchange of goods in commerce. If these numbers are to have general meaning and validity they must be based upon common units and standards. It is conceivable that an isolated manufacturer could produce effective products with his own set of measurement standards, but, if he buys or sells components from or to others or if he sells an assembled product guaranteed to meet certain performance requirements, then widely accepted measurement standards must be available. Industrial economy in the United States depends extensively upon specialty manufacturing where products are exchanged on the basis of specified physical characteristics to be determined through measurement. Hence, it is essential to have widely accepted measurement standards available to support this interchange.

Standards for measurement are also fundamental to interchange in science because the exchange of data among scientists or the use of the data of scientists by technologists would be ineffective if the measurements were based upon anything other than a commonly accepted set of measurement standards.

### ROLE OF THE NBS

THE PROVISION of standards for physical measurement has long been recognized as an essential function of government. The U. S. Constitution gives the Congress authority to fix the standard for weights and measures and this responsibility has, in turn, been assigned to the National Bureau of Standards (NBS). The responsibility today, however, is much more complex and extensive than it was in the days when the only important measurements dealt with weight, length, and volume. Measurement standards must now be available in all areas of science and technology where physical measurement is important. It is, therefore, axiomatic that the NBS in fulfilling its statutory responsibility should be intensely concerned with all the important processes of measurement.

An agency capable of competently providing the necessary standards for physical measurement is, however, in a somewhat unique position to provide a number of other related and important services to science and industry. This stems from the essential nature of useful standards for physical measurement. A standard by definition more or less represents the ultimate in precision because the numbers which arise from all measurements are derived from and therefore subordinate to the standard. Thus, those concerned with developing the standards and disseminating measurement data from them must excel in precision measurement techniques. This means that scientific and industrial laboratories should be able to look to and properly expect from a national standards laboratory advice and assistance on the effective utilization of advanced techniques in physical measurement. In addition, such competence in physical measurement enables the standards laboratory to make accurate and reliable determinations on the properties of basic materials. The provision of such data is one of the statutory functions of the NBS. The acquisition and dissemination of such data aid materially the work of scientists in other laboratories and engineers in their design problems.

Let us examine briefly one of the ways in which the ready availability of measurement standards is essential to our modern technology. A modern aircraft or missile system may include as many as a million individual components which are obtained from perhaps as many as 500 separate specialty manufacturers. Each of these components must have certain essential physical performance characteristics and all must work together in an integrated system. Assurance that each component will perform as intended is usually obtained through some sort of measurement. Assurance that the components will operate together as an effective single system is obtained if the instruments which determine their individual or collective properties are based on a common set of measurement standards. Recognizing the importance of this problem to modern aircraft and missile reliability, the defense agencies have individually initiated programs for the careful and continuous monitoring of all their instruments which control the reliability of the components in their weapons systems. Collectively they have asked the NBS to provide an up-to-date and continuing calibration service for their in-

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dividual standard control instruments. A special laboratory has been provided in Boulder, Colo., for this purpose and will be in operation shortly.

### MEASUREMENT ACTIVITIES IN THE USSR

Now let us turn to Soviet activities in the field of measurement and the relationship of such efforts to their national objectives. Problems of military strength and preparedness shall be specifically excluded because this subject is being intensively considered by others. Attention will be focused on an important segment of their efforts to increase their base for technical productivity. Soviet Union leaders have repeatedly emphasized that their major competitive objective is to overtake and excel the capitalistic nations in productivity per capita. The USSR's announced intention to compete in this area should be of immediate interest to all American industrial leaders because if we are successful in our efforts to maintain world peace, we will most certainly continue to be confronted by their challenge to excel us in terms of industrial productivity. Although we now excel the Soviet Union substantially in our production of consumer goods, we should not be lulled into believing that their technological base is not capable of being developed for such production if their leaders should so decree. The fact that they have surprised us with their ability to build first an A bomb and then an H bomb more quickly than we had expected and, more recently, to launch the first earth satellite should be ample warning that the technological foundation from which these achievements evolved is a very substantial one. Much attention has already been directed to one element of this foundation; namely, their extensive program for training scientists and engineers. There is another important element of that foundation; namely, their extensive program in the techniques of physical measurement.

Most of the information on this subject has been culled from the Soviet journal *Measurement Engineering*, the official organ of the Committee on Standards, Measures and Measurement Apparatus of the Council of Ministers of the USSR. Articles in this journal point out that the major objective of the 6th Five-Year Plan, which began in 1956, is to increase their means of production by approximately 70% and their output of consumer goods by approximately 60%. During this period, there are expected to be substantial increases in the output of basic materials and an increase in the output of their machine tool industry by approximately 80%. Fundamental to these increases in productivity, the Plan calls for extensive expansion of their instrumentation industry. All types of electrical, mechanical, optical, radiation measuring instruments, and related instruments for automation will be increased by substantial amounts, averaging about 300%.

The entire program of instrument development and production, as well as the means of utilizing their new instruments effectively is under a Committee on Standards, Measures and Measurement Apparatus of the Council of Ministers of the USSR. Five research institutions work directly for this committee on new and improved techniques for physical measurement and on the development and maintenance of the basic standards for measurement. Operating under the supervision of the institutes is a network of calibration centers. Their plan calls for 129 such centers by 1960. A major function of these calibration centers is to evaluate and approve all of the measuring instruments used in any Soviet Union production plant. One of the available reports includes an item chastizing industry for not measuring up to new precision standards and urging that greater authority be lodged in the regional calibration centers so that they will not only pass on the precision characteristics of the instruments but also upon the way in which they are used in industrial plants. Another function of the calibration centers is to make available to industry the latest advances on new measurement techniques derived from the research institutes. This is indeed a substantial chain to insure not only that new measurement techniques are developed and made available but also that they are used effectively.

One series of papers reporting on the results of a Standards and Measurement Conference held in March 1956 reveals that a sizable and high order of technical investment is being made in these areas. The conference dealt principally with standards and measurements as they applied to the machine production industry. More than 500 delegates, including research personnel, were in attendance. The conference, lasting 4 days, took up some of the most advanced problems in measurement research, problems which indicated the high degree of precision which the Soviets were seeking to obtain. Sections were devoted to production precision, interchangeability, and engineering measurement. Special attention was given to the problem of advancing the art of measurement so that it would have a direct impact on Soviet plans for automation. Their discussions of this part of the program reveal a profound understanding and extensive effort on the relationship of precision in the automation of production processes.

A description of their exhibits at the Standards and Measurement Conference reveals appreciable information on the level of their measurement competence. The United States now is in the process of comparing some Soviet levels of achievement with American standards. One item is particularly startling. This is their competence to make calibrations of temperature measuring devices. In 1956, the USSR claimed to be prepared to make calibrations of temperature measuring devices up to 6,000 C and their Five-Year Plan calls for extending this competence to 12,000 C by 1960. At the NBS, reasonably satisfactory means for providing temperature calibrations only to 2,800 C are available. We have on occasion extended such calibration by impromptu means to 4,200 C, but our capability for this and higher temperatures is severely restricted by lack of means of producing high temperatures, since our best high temperature producing device is a small solar furnace capable of attaining temperatures of about 3,500 C.

The USSR's interest and competence in making measurements at such high temperatures is indicative of a very substantial effort by the Soviet Union in development activities in this very important technological frontier. Although our knowledge of some of these Soviet activities is somewhat sketchy, it is possible to draw certain inferences: (1) the program for standards and precision measurement is operated from a higher governmental level than any other industrial activity in the USSR; (2) the investment in these areas is extremely large and seems to be especially directed toward fulfilling the precision requirement of complex automatic machine production for intended automation of large segments of Soviet industry; (3) there appears to be a clear tendency to lean heavily on theoretical analysis of technological problems and in encouraging research and development programs in the instrumentation of precise measurement; and (4) there is a program to inculcate co-operative technological efforts among relevant branches of the economy, including the Ministry of Higher Education, to advance precision measurement throughout industry. It might also be of interest to point out that the 1956 director of what apparently is the most advanced research institution in machine building technology in the USSR—the Machine Practice Institute of the Academy of Sciences—appears in 1957 as the chief Soviet delegate to discuss the IGY satellite program at the U. S. National Academy of Science.

These are all matters of serious concern to the United States. Soviet achievements in these areas must have an effect upon the American position within the community of nations. In the areas of measurement and standards, the NBS has a most critical national role. It is believed that the Bureau's essential measurement research activities must be strengthened substantially. They must be reviewed in terms both of the ominous Soviet challenge and of effective domestic technological expansion. Quite apart from any direct comparison between United States and Soviet competence, there are several areas where American inability to provide requested measurement standards services is impeding the work of scientists and engineers in other laboratories. These research programs relevant to measurement and standards competence cannot be inferior to the central Soviet effort if the United States wishes to maintain a competitive position. In addition to the ever-present military threat, the challenge in the area of basic industrial productivity has been clearly made by the Soviet Union. If this challenge is ignored or treated casually, the world status of a free-enterprise economy would effectively be undermined without a single missile ever being fired.

There are many aspects to the Soviet productivity challenge: their system of providing efficient regional calibration services with effective regulatory powers; their system of supporting these calibration services with enlarged theoretical and experimental research programs; and their systems of supporting these research programs with continued educational programs designed to expand these efforts. This approach runs counter to many of our basic attitudes toward science and technology, with little or no remedial measures to meet it. However, it is the belief of this author that both American industry and the United States Government must increase their effort toward technological advancement and must do so in a co-operative endeavor. Further, it is industry's essential responsibility to seek to develop its technological capacity, to call for and to get greater and greater measurement precision when needed, and to organize throughout the industrial complex a more consistent and enlarged system of transferring and applying measurement precision. Industry has a substantive role in meeting this challenge which, under the American system of Government, cannot be delegated to any Government agency. At the same time, the author believes that the Government has a unique and responsible role in advancing the science of measurement continuously and to the very limits of technology. The interaction of these responsibilities must be accentuated.

One area in which Government, and perhaps the NBS, could provide substantially greater service to industrial technology is that of research, collection, and publication of information on the properties of materials. Industrial organizations and scientific laboratories require large amounts of specific information on the behavior of materials under various environmental conditions. Generally, such comprehensive collections of scientific and technologic data remain uncollected or unpublished because no specific organization, private or public, has the resources to undertake such work. The NBS has, within its limited resources, done as much of this as is possible. It is hoped that it can expand these programs appropriately to satisfy the growing demand for such information. It would be one of the essential Federal contributions to technology and one which would be of vital service to America's short supply of scientific personnel.

In conclusion, it should be emphasized that only a limited but nonetheless fundamental aspect of the international technological competition has been presented. There are many other problems such as Government's and industry's responsibilities toward the support of basic research, means by which to assure that our educational system turns out increasing numbers of well-trained scientists and engineers, methods for effective utilization of our present scientific talent, ways for assuring that the results of scientific and technological advances elsewhere in the world are effectively available for domestic use, and means for improving American scientific and technical co-operation with friendly nations. Fortunately, increased attention and talent are being directed to the solution of these problems. The challenge to our standard of living and our democratic way of life, however, is of such major importance that it should be brought to the consciousness of our whole society. The economic and technologic aspects of this challenge warrant the full consideration of American industry and business.

# The Insulator Contamination Problem

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POWER COMPANIES operating in areas subjected to air-borne contamination have, for many years, been faced with a difficult operating problem. Maintenance of satisfactory operation has required that insulators be cleaned periodically by hand wiping or periodic washing (energized or de-energized). Expensive overinsulation is frequently employed to alleviate partially the effects of surface contamination.

As part of a continuing study of this problem, a test installation including surface leakage current recording equipment was installed adjacent to the Barberton High Voltage Laboratory. In 1953, several types of silicone fluids were applied to test insulators on this laboratory installation. It was felt that the water repellent and adhesive properties of such coatings would retard the accumulation of dirt on outdoor insulators as well. Effective leakage current protection was not found but it was learned that a heavy grease-like silicone compound has the ability to exude around and isolate particles of dirt that are collected by the insulators' surface. Surface leakage currents are thus reduced or eliminated.

This characteristic was further evaluated in field trials by the Southern California Edison Company. Fig. 1 shows the El Segundo switchyard where silicone compounds have demonstrated the ability to prevent flashover for periods up to one year. Previously, the substation was hot-line washed weekly.

Since the compounds are nonhardening, cleaning, when required, requires less effort than formerly. Fig. 2 shows compound treated insulators exposed to cement dust contamination for six months. Previous experience at this substation had shown that removal of cement dust deposits could not be accomplished without the use of abrasive materials or steel wool. In addition to ease of cleaning gained on the cement dust test case, the interval between cleanings was increased substantially.

**Fig. 1. Topography and location of 220-kv switchyard at El Segundo steam plant. Prevailing winds from the west drive salt spray into switchyard.**

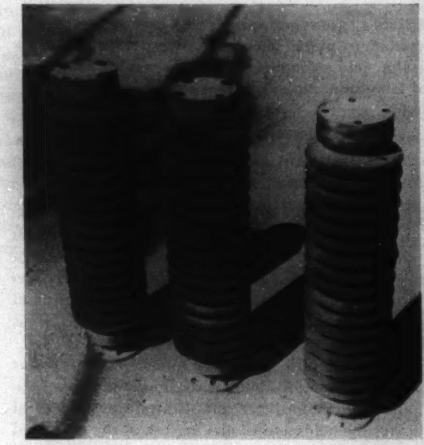

**Fig. 2. Compound treated insulators after six months' exposure to cement dust contamination.**

The compounds that are effective are tacky and so have the operating disadvantage of increasing the dirt collection rate. It is generally difficult to allay the fears of operating personnel. Compound application was generally made by hand wiping or brushing. Coating thickness was about 0.010 inch to 0.015 inch for the laboratory tests reported in this article and about 0.030 inch for the field tests. Tests indicate that useful life is proportional to original coating thickness. Where the deposits do not include extreme amounts of heavy material (such as cement dust), the effective life may be well over a year.

Chemical analysis, coupled with laboratory and field installations has demonstrated the ability of silicone compounds to prevent leakage current through surface contamination. Field use of such coating materials is an accepted operating practice where the expense of buying and applying the compound is justified by reduction in other maintenance practice.

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Digest of paper 58-22, "The Insulator Contamination Problem as Influenced by Silicone Surface Coatings," recommended by the AIEE Transmission and Distribution Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Winter General Meeting, New York, N. Y., Feb. 2-7, 1958. Scheduled for publication in AIEE *Power Apparatus and Systems*, 1958.

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# Measurement of Television Field Strength

H. T. HEAD

**Reliable propagation curves and data are needed to permit more accurate predictions of useful field strengths within the service ranges of television stations and the strength of interfering signals from other stations. This work is the responsibility of TASO Panel 4.**

PROPAGATION CURVES and data available at present for use in the television broadcast bands treat received field strengths only in terms of broad general averages, and there are needed new curves and data which will provide a more accurate assessment of specific influences affecting the received fields. This work is the responsibility of TASO Panel 4.

The field strengths in these frequency bands exhibit considerable variation, both with time and with location, and this circumstance complicates the problem of predicting the fields and of making use of the predicted characteristics. Present methods require a knowledge of three attributes of the field behavior: the median (or other percentile) field strength; the time-fading factor, which describes the variation of field strength with time at an individual receiving point; and the location factor, which describes the variation in field strength from one location to another. All of these factors are functions of several variables.

## INFLUENCES ON FIELDS

THE MOST IMPORTANT INFLUENCES on the fields in the frequency bands used for television broadcasting, in addition to radiated power, are distance from the transmitting antenna, transmitting and receiving antenna heights, frequency, and the characteristics of the transmission path. The interrelationships among these influences are complex and, at the present time, can be most satisfactorily dealt with on an empirical basis. This requires the collection and analysis of substantial quantities of field strength measurements over a sufficiently wide range of frequencies, antenna heights, and transmission paths to assure that the analysis of the measurements and the preparation of empirical propagation curves and data will take into account the more important influences.

The work can be divided rather naturally into two parts, one to deal with the field strengths within the service ranges, and the other with the field strengths within the interference ranges. Under typical conditions, this involves mileage ranges from the transmitter out to 80 or 100 miles for the service fields, and from 100 miles out to about 400 miles for the interfering fields.

Fortunately, there are already available at the Central Radio Propagation Laboratory (CRPL) of the National Bureau of Standards (NBS) large amounts of field strength records in these frequency bands, at distances in the interference ranges, collected over a period of several years. CRPL has some half-million individual observations, which have been reduced to IBM cards and which are suitable for preparing new propagation curves of field strengths in the distance ranges pertinent to the determination of interference.

At these distances, the field strength is strongly influenced by meteorological conditions over the path, especially the refractivity gradient. There are marked diurnal and seasonal effects, and in areas where tropospheric inversions are common, the fields may be considerably higher than the averages for the country as a whole. The transmitting antenna height has a less marked effect on the fields at these distances than is the case at distances well within the line of sight. In one analysis of this problem, the fields are considered to be a function of distance beyond line-of-sight; the distance from the transmitting antenna to the radio horizon, in turn, varies approximately as the square root of the transmitting antenna height.

At present, Committee 4.2 of TASO Panel 4 is preparing families of propagation curves, employing the data available through CRPL. The completed curves will show the fields as functions of frequency, distance, and antenna heights. Separate families of curves will cover the time periods from noon to 6 p.m., and from 6 p.m. to midnight. Members of Committee 4.2 on the staff of the NBS are now working on a revised mathematical model of the atmosphere as a basis of the empirical curves, which will permit taking into account such influences as varying meteorological conditions. Committee 4.2 now expects to present the completed curves to Panel 4 for approval in December 1957.

Within the service ranges of television stations, unfortunately, there is not now available such extensive information as in the interference ranges. Some information is available in the very high frequency band, but only a limited amount of reliable measurements has been taken in the ultrahigh frequencies. The available data are so limited that it has been necessary to set up a new program of collecting field strength measurements as a basis for preparing the new empirical propagation curves and for testing theories of wave propagation. This is the work of Committee 4.1.

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A special article recommended by the Television and Aural Broadcasting Systems Committee.

H. T. Head is with A. D. Ring and Associates, consulting radio engineers, Washington, D. C.

## MEASUREMENTS PROGRAM

The first step in a comprehensive program of measurements is the standardization of measuring techniques capable of yielding suitable data. The bulk of the measurements taken in the past and now available were made for the purpose of establishing the coverage areas of operating television stations. Most of these measurements are continuous mobile recordings of field strength made along roads extending generally radially outward from television and f-m transmitting antennas. The receiving antennas have been both nondirectional and directional.

Substantially all of these measurements have been made with a receiving antenna height on the order of 10 feet above ground, which is a practical height in driving along roads. However, television allocation standards assume a receiving antenna height of 30 feet, and at these frequencies the received field at 30 feet is markedly different from the field at 10 feet. Simple propagation theory, assuming a uniform spherical earth, postulates an essentially linear relationship between received field and antenna height over this range of heights; this would be an increase in the median field of 9.5 decibels from 10 feet to 30 feet. Measurements, however, show that this increase, known as the antenna height-gain function, is realized only under ideal conditions; and, in many instances, particularly at the higher frequencies and in rugged or heavily wooded terrain, the measured height-gain function may be several decibels less than predicted by simple theory.

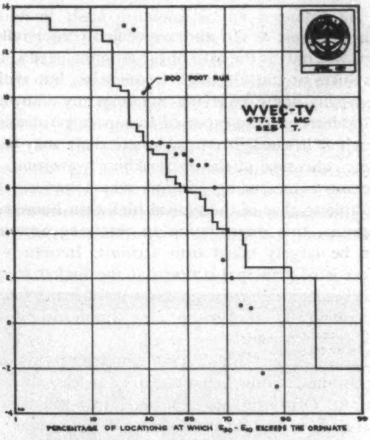


**Fig. 1. Distribution of the antenna height-gain function $E_{30} - E_{10}$ in the area of Hampton, Va.**

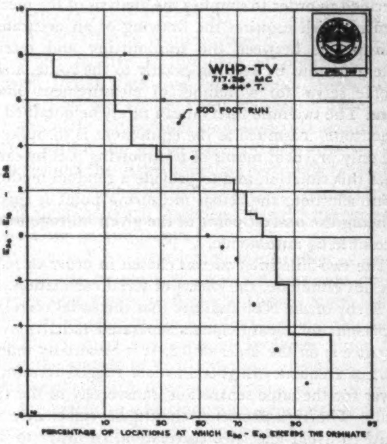


**Fig. 2. Distribution of the antenna height-gain function $E_{30} - E_{10}$ in the area north of Harrisburg, Pa.**

Examples of this condition are illustrated by Figs. 1 and 2, which are graphs of measurements of the height-gain function at two different frequencies and in two different types of terrain. In both cases, the median value of the height-gain function is appreciably less than predicted by simple theory.

Figs. 1 and 2 are graphs of the percentage distribution of the measured height-gain functions along each route. In Fig. 1, the terrain varies from flat to rolling. Most of the area is heavily wooded, principally with tall pines 50 feet or more in height. In Fig. 2, the terrain is extremely rugged, and most portions of the measuring route are well below line-of-sight from the transmitting antenna.

The measurements from which these graphs were drawn were continuous mobile measurements, made along as much of each route as practical without excessive lowering of the 30-foot antenna to pass under obstructions. The 10-foot mobile measurements were made over exactly the same routes as the 30-foot measurements, and no mobile run is less than one-half mile in length. As the graphs show, the actual height-gain function varies widely along each measuring route. In many instances, the reasons for this variation are apparent, but in equally as many areas, the cause of the variation is obscure. This is one example of the variable behavior of the fields in these frequency bands which makes it appear at the present time that the problem must be dealt with on a statistical basis.

No easy solution is seen to the problem of establishing the actual height-gain function, and it thus becomes necessary to make the measurements with a 30-foot receiving antenna height unless a different height can be adopted as an allocation standard. Fortunately, continuous mobile measurements at this height are not needed to secure data to be used in preparing propagation curves.

## TECHNIQUE USED

PANEL 4 of TASO has adopted a technique for making field strength measurements for the purposes of propagation analysis which provides for short mobile runs (100 feet along the road) to be made at the 30-foot antenna height. Spot measurements may be employed for special studies, and a "cluster" of five spot measurements may be substituted at measuring locations where the 100-foot run is impracticable. Because there often exists a fine-grained pattern of standing waves in many areas superimposed upon the directly received signal, it is desirable for these purposes to employ the short run or the "cluster" rather than the single-spot measurements.

The TASO technique prescribes measurements to be made in this manner along exact radial routes from the transmitter at two-mile intervals out to the maximum desired distance. Rigid adherence to the radial route is specified in order to simplify the analysis of the measurements, which requires the drawing of an accurate terrain profile between the transmitting and receiving antennas; thus by keeping exactly to the route, a single profile serves for a number of measurement observations. The two-mile interval can rarely be obtained with exactitude, inasmuch as the equipment is so bulky that the only practical means of transporting it is by car. To meet this situation and to provide a random method of point selection, the actual measuring point is specified as being the nearest point to the given mileage interval accessible by automobile.

The two-mile interval was chosen in order to reduce, but not eliminate, the effects of serial correlation. Data by Kirby of the NBS indicate that the serial correlation coefficient for measurements separated radially by this distance is on the order of 0.2. It is essentially independent of frequency, higher in more rugged terrain, and lower for the same separation transversely to the radial route. The measurements should be sufficiently separated to avoid excessive correlation, in order to avoid reaching the same conclusion twice without the benefit of truly independent observations.

The measuring antennas have been standardized as a simple dipole at vhf and a specified corner reflector at uhf. Not only is the gain of the antenna needed in many instances at the ultrahigh frequencies, but typical uhf high-gain home receiving antennas are known to develop less than the expected free-space gain at locations (such as in rugged terrain) where there may be incomplete coherence of the approaching wavefront. By employing a measuring antenna which has a gain comparable to that of the typical high-gain home receiving antenna, this depreciation in receiving antenna gain can be largely taken into account. Inasmuch as this effect is of principal concern at the higher frequencies and because high-gain antennas at the lower frequencies are physically cumbersome, the simple dipole antenna is specified at vhf.

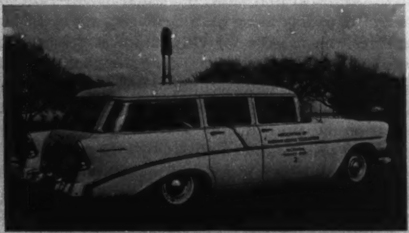


Fig. 3. MST Mobile Survey Unit No. 2. The hydraulic mast is shown in the retracted position for traveling.

Fig. 4. Mobile unit with mast extended to 30-foot height. A uhf antenna is mounted on the mast.

Measurements for TASO employing this standard technique are now being taken by at least three organizations. Our firm has equipped two vehicles for the Association of Maximum Service Telecasters (MST), one of the sponsors of TASO, and the Columbia Broadcasting System (CBS) and Westinghouse Broadcasting Company are also collecting data. The first complete survey has just been supplied to Panel 4 by MST, consisting of detailed measurements at Wilkes-Barre, Pa., on both 98.5 mc and 559.75 mc. The transmitting antennas are mounted on the same tower, with the uhf antenna directly above the vhf antenna. This is believed to be the first full-scale survey providing a direct comparison of vhf and uhf propagation over identical paths.

The equipment used in the measuring work for MST is shown in Figs. 3–6. Two identical mobile units are employed for the MST work. Mobile Unit No. 2, shown in these photographs, has completed the Wilkes-Barre measurements and is now making measurements at Madison, Wis. Mobile Unit No. 1 is completing measurements at Baton Rouge, La., following which work will be begun in Fresno, Calif. CBS will commence measurements shortly at Albany, N. Y. Westinghouse is equipping units for measurements in the New England area. Additional markets will be measured, as needed, until the data are sufficiently comprehensive to meet the requirements for the new propagation curves.

The present timetable for the work of Committee 4.1 calls for the completion of the measurements for propagation analysis by the end of April 1958. The actual analysis and fitting of empirical curves is proceeding concurrently with the making of the measurements, and propagation curves are expected to be ready within a month of the completion of the measurements.

### THEORY LINKED TO PRACTICE

FROM A THEORETICAL VIEWPOINT, more or less, television service can be specified uniquely in terms of the received field if we have reliably established the receiver terminal voltage delivered in a given field, the noise figure and sensitivity of the receiver, the unwanted signal rejection of the receiver and receiving antenna, and the subjective factors of picture quality required to make the picture acceptable to the observer. The investigation of these problems is the responsibility of Panels 1, 2, and 6 of TASO, and it is expected that numerical values can be assigned to each of these factors which will constitute a considerable advance in reliability and up-to-dateness over similar figures now in use. However, there are uncertainties in every link of the chain, not the least of which lies in the realm of wave propagation, and it is important that the values finally reached give as accurate a result as possible. One of the committees of TASO has the responsibility of assuring "that the findings . . . are not inconsistent with theory." It is equally important that the findings be consistent with practical experience; this is the responsibility of Panel 3 of TASO.

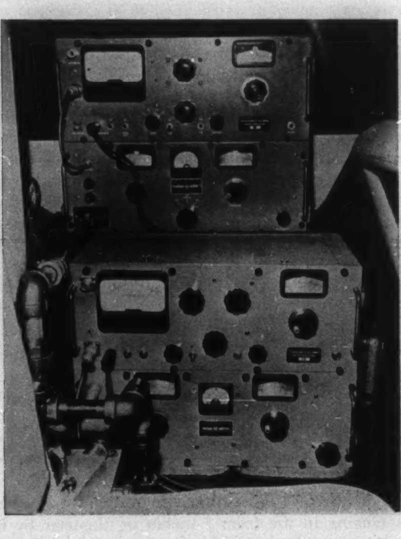


Fig. 5. Interior of mobile unit showing field intensity meters.

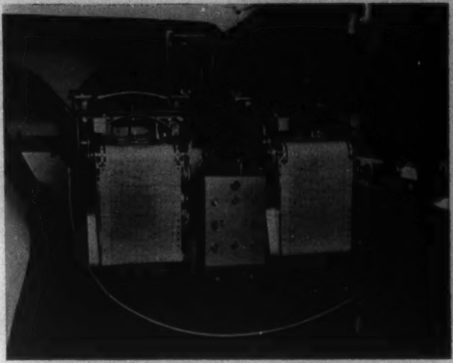


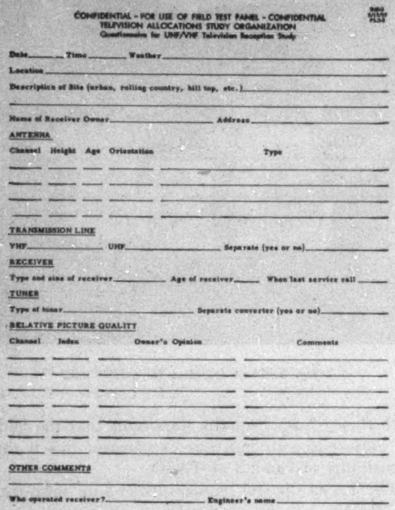
Fig. 6. Chart recorders for mobile unit.

The TASO Charter requires Panel 3 to "measure and observe the relative performance of present-day and advanced design receiving equipment (monochrome and color) in the vhf and uhf frequency bands," in order to "make evaluations of the picture quality obtainable within the service areas of television stations and determine the actual practical performance, including . . . correlation between observed picture quality and the signal strength provided." Panel 3 has attacked this problem on two fronts.

It is expected that considerable information at a practical level may be obtained from the television dealers and television service men of the United States, based on their experience in the installation and servicing of the Nation's operating television receivers. Here, too, may lie the answer to such important questions as the typical height of the receiving antenna in weak signal areas, the extent to which the man who installs the receiving antenna probes the immediate area to find the maximum usable signal, and the extent to which the typical installation may deteriorate in actual practice.

Information of this nature is being sought by means of a questionnaire, prepared by Panel 3, and circulated through the auspices of the National Alliance of Television and Electronic Service Organizations to some 10,000 servicemen throughout the United States. Returns from the questionnaire have begun to come in, and the response has been gratifying. The information received through this source ultimately will be tabulated by business machine methods by the Burroughs Corporation through the Burroughs Research Center, whose director is Knox McIlwain.

Simultaneously with the circulation of the servicemen's questionnaire, Committee 3.3 is conducting a program of house-to-house interviews by trained teams to evaluate actual picture quality. These interviews are now taking place in Baton Rouge, La., and Madison,



CONFIDENTIAL - FOR USE OF FIELD TEST PANEL - CONFIDENTIAL
TELEVISION ALLOCATIONS STUDY ORGANIZATION
Questionnaire for UHF/VHF Television Reception Study

Date_____ Time _____ Weather _____
Location _____
Description of Site (urban, rolling country, hill top, etc.) _____
Name of Receiver Owner _____ Address _____

ANTENNA

| Channel | Height | Age | Orientation | Type |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |

TRANSMISSION LINE

VHF _____ UHF _____ Separate (yes or no) _____

RECEIVER

Type and size of receiver _____ Age of receiver _____ When last service call _____

TUNER

Type of tuner _____ Separate converter (yes or no) _____

RELATIVE PICTURE QUALITY

| Channel | Index | Owner's Opinion | Comments |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

OTHER COMMENTS

Who operated receiver? _____ Engineer's name _____

**Fig. 7. Questionnaire used by Committee 3.3 in conducting house-to-house interview surveys.**

where the MST field crews are making simultaneous field strength measurements, and additional markets will be surveyed in conjunction with the field strength measuring crews. In the interviews, the interviewer, after gaining access to the household, requests the householder to turn on and tune the receiver to each receivable station. The interviewer asks the householder to give his estimate of the picture quality, using the scale: "Excellent," "Good," "Passable," "Not Quite Passable," "Poor," and "Not Usable"; the interviewer, who is technically trained, also gives his own estimate for the reception of each station. The interviewer records the details of the receiver installation, and asks the householder some simple questions concerning recent service to the installation. A sample questionnaire is Fig. 7.

While the interview team of two men is in the home, the field strength measuring crew measures the signals. Field strength measurements and interviews are made at approximately 13 homes in a given small area, and continuous 10-foot mobile measurements are made on two of the stations. All receivable signals are measured in the road at the 30-foot antenna height and, in addition, at four homes in the area the fields are measured at 30 feet in the viewer's driveway, as near his receiving antenna as possible.

The purposes of these additional field strength measurements are several. First, it is desired to establish as close a correlation as possible between observed picture quality and the field in the immediate vicinity of the customer's antenna. Second, it is desired to determine whether the practice of measuring field strength in the roads opposite dwellings rather than immediately adjacent to the receiving antennas, introduces any bias in the results. Third, it is desired to determine whether the present method of random point selection, which is now biased to the extent of requiring all measuring locations to be accessible by car (i.e., on or very near roads), introduces an undesirable bias into the results. And fourth, it is desired to determine whether there is any prospect of specifying quality of service in terms of the field at 10 feet instead of 30 feet.

In this last consideration, the 30-foot measurements have been found to involve considerable labor and hazard. The work progresses slowly—there have been several accidents (two fatal) involving the operation of a 30-foot mast. The standard technique for collecting field strength data is for analysis purposes, and no recommendations have been made by TASO for collecting data primarily for station coverage purposes. A standard for this purpose must await the collection of further information through the work of Panel 3. The NBS has proposed a radically new method of specifying and measuring service areas, and all of these proposals must be tested and weighed in order to reach an ultimate coverage measuring method.

The time schedules for these field strength measurements have been established to meet the present target date of June 30, 1958, for the completion of the work of TASO. All of the work is actively under way, and results are beginning to show. Through this activity, Panels 3 and 4 are hopeful of contributing a worth-while advance through TASO to the television engineering art.

# High-Vacuum Furnaces

A new series of induction-heated high-vacuum furnaces with temperature capabilities ranging 2,000-2,600 C have been developed by the Vacuum Equipment Division, F. J. Stokes Corporation, Philadelphia, Pa.

With their extended upper-temperature limits, these furnaces are especially suitable for vacuum sintering of materials such as tantalum compacts for electrical capacitors or special high purity carbides. A graphite, molybdenum, or tantalum susceptor, depending on the application, is used to create high temperatures around the material being sintered. The susceptor is heated by a conventional induction power supply. Complete instrumentation for temperature control and recording is provided as a part of the system.

High-vacuum operating conditions in the order of 0.1 micron and less are developed and maintained through combination pumping systems consisting of Stokes "Microvac" mechanical pumps and "Ring-Jet" oil vapor diffusion and booster pumps.

Units are available with uniform temperature work zones ranging in size from 3 inches in diameter by 6 inches high to 8 inch diameter by 12 inches high.

# 138-Kv Isolated-Phase Bus and Switching Structure

R. H. ALBRIGHT
MEMBER AIEE

A DEFINITE TREND has been indicated toward higher subtransmission voltages to meet increasing load demands in certain metropolitan areas. High-voltage metal-enclosed isolated-phase bus structures offer a practical and economical solution to the bus and switching needs at these higher voltages and have many advantages such as simplification of arrangement, greater flexibility, and greater safety. Following this trend, the Consolidated Edison Company of New York installed a 138-kv metal-enclosed isolated-phase bus and switching structure at their East River plant. The bus structure provides for four 138-kv incoming circuits and six 69-kv circuits. Limited space made it necessary to mount the equipment at several levels (Fig. 1).

The bus and switching structure as furnished for this installation included all of the desirable features of lower-voltage isolated-phase bus and switching structures. It was designed for a continuous current of 1,200 amperes; momentary current of 60,000 amperes; 60-cycle withstand of 310 kv; and no measurable corona discharge at 145 kv, 60 cycles (85 kv line to ground).

The basic design was determined from previous experience, studies, and tests. Round enclosures with three insulators at each support position were selected, inasmuch as they proved to be most economical and provided sufficiently high dielectric characteristics within limited dimensions (Fig. 2).

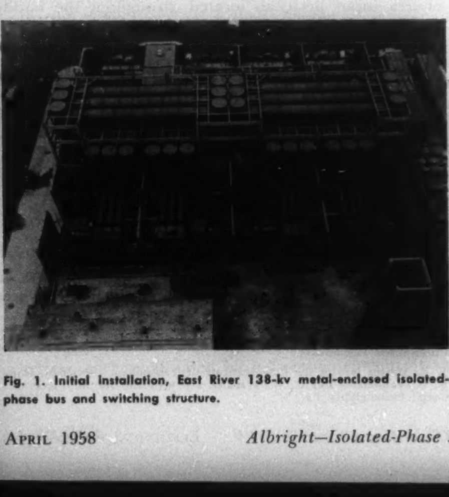


Fig. 1. Initial installation, East River 138-kv metal-enclosed isolated-phase bus and switching structure.

Bus enclosures of 80-inch inside diameter were made in sections of moderate lengths to conform with the bus arrangement, to facilitate erection in the complex supporting structure, and to minimize the stress problems introduced by expansion and contraction on temperature changes. Access to the enclosures is provided by removable covers. Neoprene rubber gaskets were used as expansion joints between adjacent housing sections and to effect a weatherproof seal.

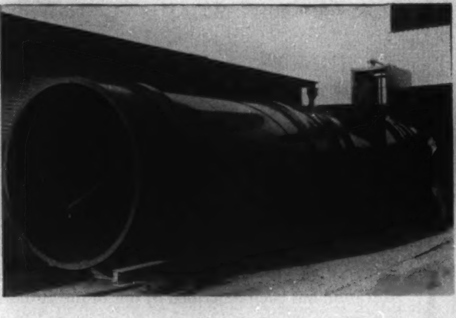


Fig. 2. Factory assembly of 138-kv bus and switch housings.

Provisions were included for longitudinal, transverse, and vertical adjustments of housings on installation. These adjustments facilitated erection and eliminated the necessity of critical alignment of the main structural supporting members.

Bus conductors and switch parts were supported on porcelain insulators designed for the specific application. Switches were of the double-break contact type with the blades actuated in a plane perpendicular to the longitudinal switch axis by screw drives. Since the 138-kv installation, a new telescoping blade switch has been developed for isolated phase bus structures. It can be mounted in a housing of the same size as the bus with which it is used, requires a low operating effort and relatively short operating time, and can be shielded most effectively to provide high dielectric characteristics. Blades are operated through torsional insulators.

The metal-enclosed isolated-phase bus as used on this 138-kv installation, along with the telescoping blade switch, provides a practical and economical solution for high-voltage bus and switching structures in areas where open-type switchgear is not acceptable. The design is applicable to a multitude of bus and switching arrangements and requires a minimum of space. It provides high mechanical and dielectric strengths in weatherproof enclosures to assure continuous and prolonged service with minimum maintenance.

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Digest of paper 58-127, "138-Kv Metal-Enclosed Isolated-Phase Bus and Switching Structure," recommended by the AIEE Transformers Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Winter General Meeting, New York, N. Y., Feb. 2-7, 1958. Scheduled for publication in AIEE *Power Apparatus and Systems,* 1958.

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# Remote Control Carrier Systems in Two-Way Closed-Circuit Educational TV

J. R. MARTIN G. W. WARNICK R. N. VANDELAND

**"Person to person" type of instruction is made possible by the use of a radio rather than a video frequency distribution system. This also permits use of modulated carrier controls which greatly increases the flexibility of the presentation.**

THE USE of two-way closed-circuit television in education has been described by one of the authors in a recent article in *Electrical Engineering*.[1] In a two-way system, cameras placed in remote classrooms, as well as at the instructor's position, permit a "person-to-person" type of instruction which seems to offer several advantages over one-way operation. This type of instruction is possible if radio rather than video frequency is used for the distribution system. Radio frequency distribution also permits the use of modulated carrier controls in such a way as to increase greatly the effectiveness of the instructional presentation.

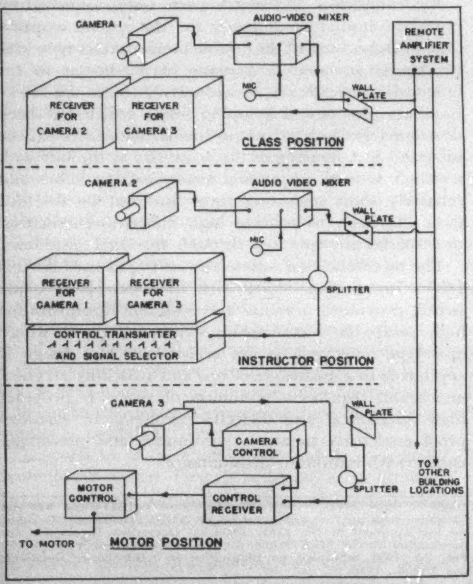
CAMERA I
AUDIO-VIDEO MIXER
REMOTE AMPLIFIER SYSTEM
MIC
WALL PLATE
RECEIVER FOR CAMERA 2
RECEIVER FOR CAMERA 3
CLASS POSITION
CAMERA 2
AUDIO VIDEO MIXER
WALL PLATE
MIC
RECEIVER FOR CAMERA I
RECEIVER FOR CAMERA 3
SPLITTER
CONTROL TRANSMITTER AND SIGNAL SELECTOR
INSTRUCTOR POSITION
CAMERA 3
WALL PLATE
CAMERA CONTROL
TO OTHER BUILDING LOCATIONS
MOTOR CONTROL
CONTROL RECEIVER
SPLITTER
TO MOTOR
MOTOR POSITION

**Fig. 1. Multiplex camera and remote control.**

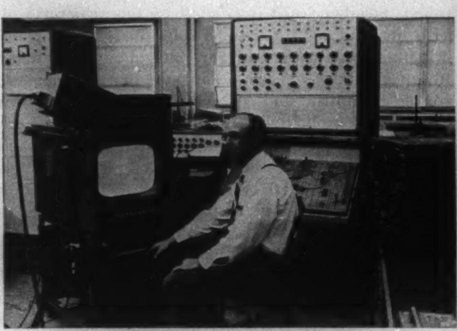

**Fig. 2. Computer position.**

The combination of two-way video operation with modulated carrier control enables an instructor to operate remote equipment, view the equipment performance by means of a camera which he controls, and at the same time be in direct video and audio contact with remote classes who view the instructor and the controlled equipment simultaneously. All of the visual, audio, and control information is carried over a single coaxial line.

This type of operation has been used at Case Institute of Technology to study its application for both teaching and research. The electrical engineering building at Case has a radio frequency distribution system with 27 camera input positions located throughout the building. These are connected through a single coaxial line to a central unattended amplifier unit, the output of which is fed to 38 receiver positions, also distributed throughout the building.[2] The amplifier unit consists of four amplifiers tuned to Channels 2, 4, 6, and 8 of the standard vhf television band. An additional low-frequency amplifier may be used, if necessary, for the modulated carrier control signals.

### DESCRIPTION OF MODULATED CARRIER CONTROL

One form in which the control system has been used is illustrated in Fig. 1, and in the photographs, Figs. 2, 3, and 4. This particular application will be described

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A special article recommended for publication by the Educational Publications Committee.

J. R. Martin is with the Case Institute of Technology, Cleveland, Ohio; R. N. Vandeland and G. W. Warnick are with the Jerrold Electronics Corp., Philadelphia, Pa.

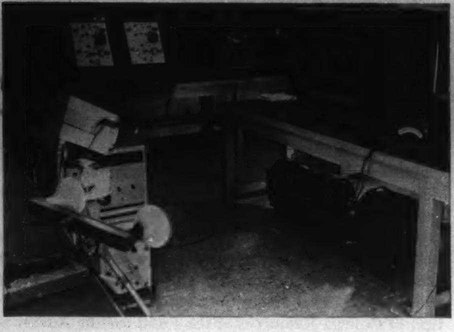

Fig. 3. Remote motor position.

Fig. 4. Remote classroom.

in some detail, because it illustrates a number of unique applications to educational closed-circuit television. An instructor in the computer laboratory has operated an analog computer in order to solve a problem on motor operation (Fig. 2). A camera at this location, operating on one vhf channel, permits a class in a remote position to observe the operation of the computer even more clearly than if it were physically present at the computer position. A camera, located in the classroom and operating on another channel, provides two-way audio and video contact between instructor and students and, thus, permits discussion on computer operation and the solution of the problem. After the problem has been solved, the instructor transmits the necessary data to a motor located in a third position (the industrial electronics laboratory) by means of the carrier control system so as to start, stop, reverse, and vary the speed of the motor in accordance with the computed data. At the same time, by means of another group of carrier control signals, he is able to pan, tilt, change lenses, focus, and change the lens aperture of a third camera which views the motor, motor control, and all instruments indicating motor operation. This camera transmits the video signal on a third channel to receivers at both the instructor and class positions. Figs. 3 and 4 show the motor and classroom positions for the situation described. Two receivers are normally located in the student position to permit simultaneous viewing of both the instructor and the controlled equipment. Two receivers would also usually be located with the instructor, although as shown in Fig. 2, only one need be used and switched to either channel as desired.

With present facilities at Case, one additional two-way position (either class or equipment) could be used. Two more tuned amplifiers for Channels 10 and 12 would extend the system to a total of six two-way audio-video channels with reception on standard commercial television receivers. Almost any number of control signals can be used by choosing a multiplicity of carriers, each modulated by a number of control impulses.

Operation of the control equipment can be understood by referring to Fig. 5, which also shows connections to the remote amplifier. A group of audio signals are used to modulate a stable oscillator set at the desired carrier frequency. The modulated carrier is then transmitted over the coaxial system to the remote equipment to be controlled. At this point, the particular carrier used is selected by a tuned circuit and applied to a demodulator, the output of which operates a group of relays, each adjusted to respond to the several signals

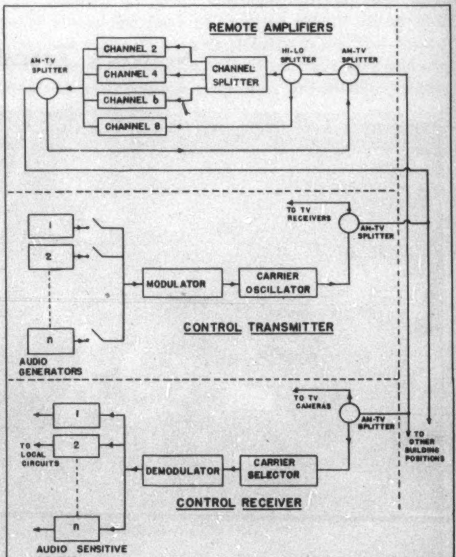
REMOTE AMPLIFIERS
AM-TV SPLITTER
CHANNEL 2
CHANNEL 4
CHANNEL 6
CHANNEL 8
CHANNEL SPLITTER
HI-LO SPLITTER
AM-TV SPLITTER
TO TV RECEIVERS
AM-TV SPLITTER
1
2
n
AUDIO GENERATORS
MODULATOR
CARRIER OSCILLATOR
CONTROL TRANSMITTER
TO TV CAMERAS
AM-TV SPLITTER
TO OTHER BUILDING POSITIONS
1
2
n
TO LOCAL CIRCUITS
DEMODULATOR
CARRIER SELECTOR
CONTROL RECEIVER
AUDIO SENSITIVE RELAYS

Fig. 5. Remote amplifiers and carrier control.

used for modulation. The relays close local circuits to give any desired operation. Tones, pulses, or coded pulses with either amplitude or frequency modulation can be used, as can any number of carrier frequencies within the limits of the selector circuits, side bands generated, and the transmission characteristics of the coaxial cable. In the experiment described, 250-kc and 350-kc carriers were used, and each frequency was modulated by eight control signal sinusoidal tones. The same eight tones were used for both carriers. The "AM–TV splitters" shown are frequency dividing networks and are used to separate the low radio frequency carriers from the vhf television signals. Similarly, the "Hi-Lo splitter" divides the 54- to 88-mc channels from the 174- to 216-mc channels of the vhf television band.

### PROGRAM IN PROGRESS

MANY RESEARCH POSSIBILITIES are suggested by such an experiment. For example, a servo loop could be installed between the two operating positions so that the motor could, by means of a second modulated carrier, feed back information and give automatic operation according to a predetermined program. With present facilities at Case, a research worker can operate, control, and observe four separate experimental systems in four remote locations. Not only visual, but also other quantitative data can be fed back from the instrument positions to the operating center and to any or all of the 38 receiver positions.

Aside from research applications, the use of a modulated control system is evident for classroom instruction. An instructor in one location can control the operation of cameras in several remote classrooms in order to view the entire class or particular individuals. By remotely switching channels on classroom receivers, person-to-person contact between students in different classrooms can also be obtained.

The utilization of such methods for educational purposes and for scientific research is now being studied at Case Institute of Technology as one part of a general study under a grant from the Committee on the Utilization of College Resources of the Fund for the Advancement of Education. The control system was developed by the Jerrold Electronics Corporation, collaborating with Case in examining its usefulness in educational situations. Other studies being made under the grant include two-way television instruction, closed-circuit television as a teaching aid, and further applications to scientific research problems.

### REFERENCES

1. Two-Way Educational Closed-Circuit Television, J. R. Martin. *Electrical Engineering*, vol. 76, No. 10, Oct. 1957, pp. 921-24.

2. Developments in Closed-Circuit Television, M. H. Kraus. *Electrical Engineering*, vol. 74, No. 11, Nov. 1955, pp. 974-79.

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# Network Transformer Height Cut

Height reductions of 9 to 12 inches on General Electric's network transformers will enable utilities to save money on new vault construction and to pack more capacity into existing vaults.

Called "Vault-Master" transformers, the new line includes three-phase ratings from 300 to 1,000 kva in the 15-kv class, and later will be extended to the 22-kv class. Low height has been achieved by a complete redesign.

Improved grain orientation of core steel and a new laced-core design permit a smaller core and coil for the same kva output.

This compact core and coil has a more balanced thermal design and a lower heat gradient. All parts of the unit work more uniformly without raising the temperature of the hottest spot—the limiting factor in insulation life.

Internal size reduction permits increasing the space between tank and flat-panel radiators for better dissipation of heat without increasing the floor area of the whole transformer.

Throat connections for network protectors have been lowered also, from 3 to 15 inches, to keep the protectors in all ratings and even the protector bushings in most ratings below the level of the transformer top.

# Telephone System Transmission Performance Objectives

W. K. MacADAM
MEMBER AIEE

IN A TELEPHONE SYSTEM, one of the main factors affecting quality of service is received volume. For particular talker volume distributions and listener hearing ability, this volume is determined by circuit losses between telephones and by the set efficiencies.

Much work has been done in the past in attempting to relate volumes and losses with changing customer preferences. For example, subjective tests by Reier and Coolidge at the Bell Laboratories involved thousands of volume observations by a variety of listeners. These listeners grouped received volumes into categories such as "Excellent," "Good," "Fair," or "Poor" on the basis of both appraisal and comparison.

Recently, the Reier and Coolidge data were used as a basis for evaluating listener preferences under various circuit loss conditions. This was done by determining the distribution of received volumes, and hence ratings, that results from combining typical talker volume distributions with various trunk and loop loss conditions.

Fig. 1 is the result of this statistical combination, considering trunked calls of any type. It shows what typical user reactions would be to trunk loss distributions having particular averages, assuming the same typical loop loss distributions in each case. This also assumes typical set efficiencies and over-all bandwidth.

Recognizing that, at present, increased volume costs money, the data plotted in Fig. 1 suggest setting a goal for volumes on the low side of "Excellent," but not so low that any appreciable per cent are "Poor" by design. This results in the present Bell System average trunk loss goals of about 4 db as shown in the illustration. Qualitywise, by present preferences, this is represented as a negligible per cent "Poor," about 5% "Fair," and the balance "Good" or "Excellent."

Because the existing plant is composed, in part, of installations made in the past under more lenient customer preferences, the going average is somewhat below present goals for new plants. This is shown in Fig. 1 by the 7-db average trunk loss marked "Today's Inherited Designs."

To evaluate how the plant actually performs as related to these objectives, direct measurements of trunk and loop conditions are helpful. However, they are only indirect measurements of what the telephone user feels about the quality of service. The closer one gets to the customer in examining the quality of service, the better is the measure of the job being done and of the work that lies ahead.

Three principal schemes currently are being used in the Bell System to measure the product as it is actually delivered. In the first place, a selected sampling of customer opinion is being made annually by means of home visits. Known as the "Customer Attitude Survey," it includes questions on the cost of service, quality of service, and opinion of the telephone company. The "quality of service" portion of this survey contains questions on the grade of transmission experienced.

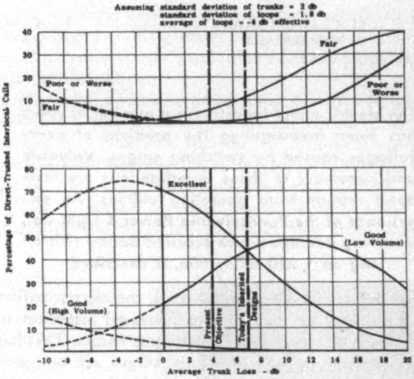

Fig. 1. Customer rating of transmission (trunked calls).

In addition to direct customer surveys, two additional means are used to measure quality of service. These are made on circuits actually in use and consist of volume measurements in local central offices and observations of repetition rates, and transmission irregularities on intercity calls.

The volume surveys were started early in 1957. Initial results show about 4% "Poor," 15% "Fair," and the balance "Good" or "Excellent"—somewhat short of the current goal. The repetition rate studies are, at present, useful primarily in comparing performance by localities and in studying trends. However, work is under way to relate them to volumes and, hence, to customer preferences.

An appreciation of the background of customer derived objectives permits establishment of an intelligent and prudent program for up-dating existing plant to modern requirements. Indeed, it emphasizes the flexibility needed in present designs to care for future changes. With service the main telephone product, its quality control is not a luxury but a business necessity.

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Digest of paper 58-59, "A Basis for Transmission Performance Objectives in a Telephone Communication System," recommended by the AIEE Wire Communication Systems Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Winter General Meeting, New York, N. Y., Feb. 2-7, 1958. Scheduled for publication in AIEE *Communication and Electronics*, 1958.

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# Breaker Restriking and Arrester Destruction on a 220-Kv System

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**The electric utility industry for a number of years has been investigating the problem of overvoltages caused by switching surges. Valuable and necessary to these investigations are first-hand reports from operating utilities. An experience of the Pennsylvania Power & Light Co., involving damage which occurred during switching on a 220-kv system, is described.**

DURING the past several years, the electric utility industry has had to give increased attention to overvoltages caused by switching surges. This has been necessary because switching surges are not well defined and their relationships with basic impulse levels, lightning arrester thermal capability, high and extrahigh transmission voltages, restriking breakers, and system design and configuration require more investigation by the industry. The experience of the operating electric utilities play an important part in determining where additional research is needed. This article presents an experience of Pennsylvania Power & Light Co., which involved damage to an oil circuit breaker (OCB) and lightning arresters during switching on a 220-kv system. The investigation of these damages was conducted on the actual system and a transient network analyzer. Several papers[1,2] in the past have presented results of transient network analyzer studies which involved switching surges on high-voltage lines and stations for generalized systems. In this article, transient analyzer results are included for a specific system, with actual operating conditions and equipment characteristics simulated.

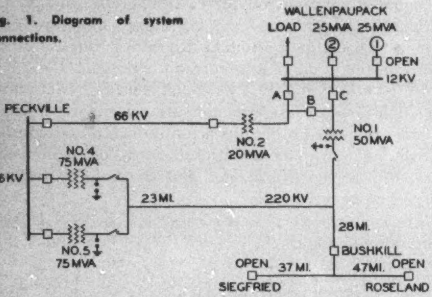

**Fig. 1. Diagram of system connections.**

## SYSTEM AND EQUIPMENT INVOLVED

THE PART of the 220-kv system involved in this experience is located in eastern Pennsylvania and includes 220-kv lines which connect Scranton and Allentown, Pa., and Newark, N.J. Fig. 1 shows schematically the equipment connections, ratings, and line mileage. The damaged equipment included two 182-kv station-type lightning arresters at Peckville and one 196/230-kv 5,000-mva OCB at Bushkill.

On December 2, 1956, the system was switched as part of a test for the carrier-current control relays at Siegfried, Bushkill, and Roseland substations. For this purpose, the Siegfried and Roseland terminals of the lines were opened. The Wallenpaupack and Peckville terminals were left closed, one generator was placed in service at Wallenpaupack, and the 66-kv Wallenpaupack–Peckville tie was closed. Fig. 1 shows the system as it was prior to the time of the failure. The Bushkill OCB was used to drop the Siegfried–Roseland line four times in a 6-minute period. Because of the automatic reclosing controls on the breakers, a total of seven tripping operations resulted. After the seventh operation, the transformer OCB's at Peckville opened and the 12-kv OCB's *B* and *C* at Wallenpaupack opened, de-energizing the 220-kv line. At Wallenpaupack, the 12-kv OCB *A* and the no. 2 machine OCB opened immediately thereafter, interrupting the local load.

Testing of the 220-kv line revealed that the line was permanently faulted. The fault was found to be in two lightning arresters at Peckville, one on phase *B* of transformer 4 and one on phase *C* of transformer 5. Physical inspection of the lightning arresters showed complete internal destruction. The end plates were bulged and the bolts holding the end plate to the casting were sheared, thus relieving the internal pressure and preventing fracture of the porcelain.

## SYSTEM TESTS

SWITCHING TESTS were made on January 8, 1957, to determine if and how many times the Bushkill breaker would restrike during line-dropping operations. These tests involved dropping the 51-mile Bushkill–Peckville 220-kv line, with the transformers at Peckville and Wallenpaupack disconnected. A magnetic oscillograph

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Full text of paper 58-94, "An Experience with Breaker Restriking and Arrester Destruction on the Pennsylvania Power & Light Co. 220-Kv System," presented at the AIEE Winter General Meeting, New York, N. Y., Feb. 2-7, 1958. Recommended for publication by the AIEE Switchgear and Protective Devices Committees. Scheduled for publication in AIEE *Power Apparatus and Systems*, 1958.

M. C. Galiyano, C. A. MacArthur, and W. F. Mackenzie are with the Pennsylvania Power & Light Co., Allentown, Pa.

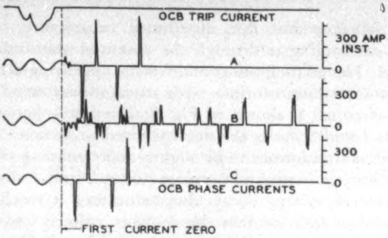


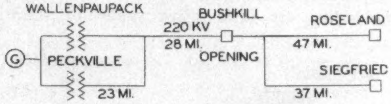
**Fig. 2. Oscillogram of Bushkill breaker currents when dropping 220-kv Bushkill–Peckville line.**

was installed at Bushkill to record the breaker currents. Fig. 2 shows a typical oscillogram of one of the line-dropping operations. On this oscillogram, phase *B* showed multiple reignitions and restrikes for about 7 cycles after the first current zero. These were erratic and there were two per voltage reversal, indicating there probably was an abnormal leakage path. On both *A* and *C* phases, there were 4 restrikes, one for each voltage reversal. The restrike currents have crest values of 200 to 500 amperes with 700 to 1,200 microseconds duration. On phases *A* and *C*, all of the current conductions are actual restrikes with a somewhat random timing. On the evidence of the reignitions and restrikes of phase *B* current record, it was decided that the system tests should be stopped and immediate arrangements made to inspect the breaker interrupters.

Internal inspection of the breaker showed rather severe damage to some of its interrupters. One interrupter pot of both *B* and *C* phases had a puncture in the insulation. The grading resistor of phase *B* had been damaged by a flashover and provided an abnormal conducting path for the entire length of the interrupter. All of this damage occurred on the side of the breaker that is connected to the Siegfried–Roseland Line. No major damage occurred on phase *A*. The damage to phase *B* clearly explains the prolonged restriking. With the damaged grading resistor, this phase could not build up sufficient recovery insulation until the main bayonet left the interrupter.

When the system switching tests showed excessive restriking, it was decided to study the effects of these restrikes on a transient analyzer, by means of which the system could be represented in miniature and the many varied conditions easily controlled and studied.

The transient analyzer study showed that when dropping the Siegfried–Roseland line from Bushkill, restrikes on the Bushkill breaker cause a transient overvoltage at Peckville which is in excess of the switching surge sparkover value for the 182-kv rms rated arresters there. The top series of oscillograms of Fig. 3 show the transient currents and voltages caused by these restrikes. The Peckville voltage (voltage across the arresters) and arrester current due to a restrike in the first phase to clear are shown in Fig. 4. This transient overvoltage causes the Peckville arresters to discharge a peak current of 400 amperes with current conduction for 500 microseconds. The arrester was open-circuited at the first arrester current zero.



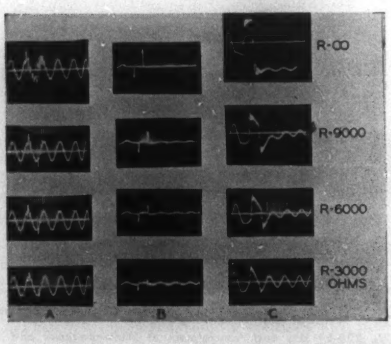
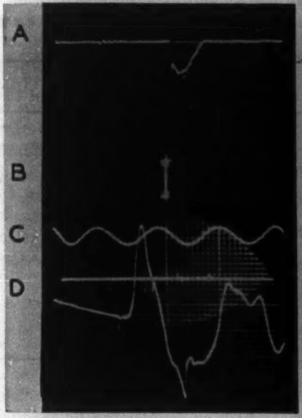


**Fig. 3. Transient analyzer oscillograms showing effects of discharge resistors across breaker contacts when dropping Siegfried–Roseland line with two restrikes. *A.* Peckville 220-kv voltage. *B.* Bushkill current. *C.* Siegfried 220-kv voltage.**



**A. Arrester current**
**B. Voltage and current calibration, 19 kv and 63 amperes (crest) per division**
**C. 1,000-cycle timing wave**
**D. 220-kv voltage at Peckville**

**Fig. 4. Transient analyzer oscillogram of Peckville lightning arrester operation, with 220-kv system energized from Peckville and Wallenpaupack. Opening Bushkill OCB to drop Siegfried–Roseland line. Phase *A* opens and restrikes. Arrester is sparked over at 430 kv and open-circuited at the first arrester current zero.**

On December 2, 1956, the Siegfried–Roseland line was dropped from Bushkill seven times. Assuming a

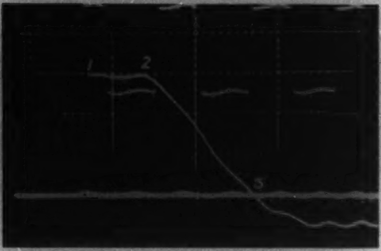


**Fig. 5. Transient analyzer oscillogram of voltage across potential transformer at Bushkill, when dissipating the trapped charge on Siegfried–Roseland line. Square timing wave is 60 cps.**

minimum of two or three restrikes for each line-dropping operation, the arresters would have discharged switching and power-follow current for two or three successive half cycles seven times in a 6-minute period.

**Table I. Per-Unit Voltages Reached when Dropping the Siegfried–Roseland Line**

| Station and Condition | Total Resistor Ohms 3,000 | 6,000 | 9,000 | Infinite |
|---|---|---|---|---|
| Siegfried (trapped charge just before first restrike) | 0.0 | 0.6 | 0.8 | 1.28 |
| Siegfried (trapped charge just after first restrike) | 1.54 | 1.84 | 2.00 | 2.46 |
| Peckville (just after first restrike) | 1.50 | 1.70 | 1.96 | 2.24 |
| Siegfried (trapped charge just before second restrike) | 0.0 | 0.4 | 0.75 | 2.46 |
| Siegfried (trapped charge just after second restrike) | 0.8 | 1.58 | 2.00 | 3.46 |
| Peckville (just after second restrikes) | 1.1 | 1.5 | 1.8 | 2.6 |

Because this series of discharge currents is greater than that which an arrester can be expected to withstand, it was concluded that the arresters were destroyed by cumulative heating.

The system test oscillogram, Fig. 2, clearly shows multiple restriking on all phases during dropping of the tap line. Assuming that similar performance would be obtained when dropping the Siegfried–Roseland line, the transient analyzer results satisfactorily explain the arrester destruction experienced on phases *B* and *C*. However, they do not explain why the phase *A* arrester and phase *A* of the OCB were not damaged.

At Bushkill, a single-phase 138,000/184-volt phase-to-neutral potential transformer is permanently connected on phase *A* of the Siegfried–Roseland line, and is used for calibration purposes and to supply the 15-kva station service power requirements. Any decay of the trapped charge through this transformer in the first half cycle after current zero would reduce the recovery voltage seen by the breaker on this phase. The analyzer was used to determine the effect that this transformer has upon the rate of decay for a trapped charge. This was done by charging a capacitor, equivalent to the Siegfried–Roseland line distributed capacitance, and then discharging it through the potential transformer model. The oscillogram of the voltage appearing across the potential transformer with its secondary winding open-circuited is shown in Fig. 5. The curve between points 1 and 2 shows the time required to saturate the potential transformer to be slightly more than $\frac{1}{2}$ cycle on a 60-cycle basis, and between points 2 and 3 shows the rate of voltage decay after saturation is reached. These data indicate that the recovery voltage seen by the breaker is not reduced because of this transformer. Transformer secondary loads, equal to the station service power requirements, would not materially change the times which were obtained with the open-circuited impedance. Consequently, it is planned to remove the phase *A* arresters and have the internal parts tested for any loss of life and changes in characteristics.

Power transformers, because of their lower magnetizing impedance, saturate and discharge the line in a much shorter time than potential transformers. The oscillograms in Fig. 6 show this effect when the Peckville line and transformers are dropped from Bushkill. Two restrikes were included in this switching. When a line and power transformer are switched as a unit, the recovery voltage on the interrupting breaker is reduced to the point that restriking is unlikely. However, if restriking occurs, no serious transient overvoltages are produced.

The effects of breaker shunting resistors on the trapped charge when dropping the Siegfried–Roseland line from Bushkill were investigated using the transient analyzer. Three values of resistances (3,000, 6,000, and 9,000 ohms) and open circuit were included. Shown in oscillogram form, Fig. 3, are the Bushkill current, Peckville voltage, and the charge trapped on the Siegfried–Roseland line for these three values of shunting

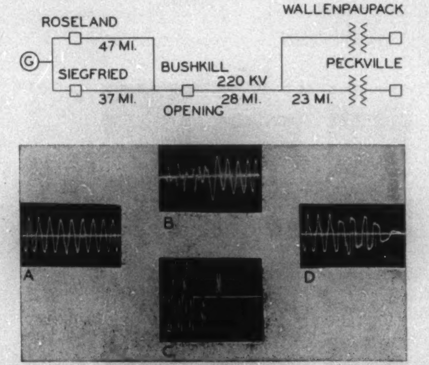


**Fig. 6. Transient analyzer oscillograms obtained when Peckville 220-kv line and transformers at Wallenpaupack and Peckville are dropped as a unit by opening Bushkill OCB with two restrikes. *A*. Voltage on source side of Bushkill breaker. *B*. Voltage across Bushkill breaker. *C*. Current through Bushkill breaker. *D*. Peckville voltage.**

resistances and open circuit with two restrikes. Table I gives the numerical values for the voltages reached at each station. These show the beneficial influence of a shunting resistor in preventing system overvoltages from line-dropping operations.

With the system arrangement involved, there is a strong possibility that a small generator may be left connected to a long 220-kv line. The line-charging kva will effectively increase the excitation of the generator and result in abnormally high terminal voltages. Calculations[3] plus the steady-state study on the transient analyzer model indicate that the voltages attained would not be high enough to spark over the Peckville 182-kv class arresters, but they would be sufficient to prevent sealing off the arresters if they had been sparked over by some other voltage surge. Fig. 7 shows the voltages attained for this condition. Because of the transformer saturation, the degree of overvoltage at Peckville is practically the same regardless of the initial loading of the Wallenpaupack generators.

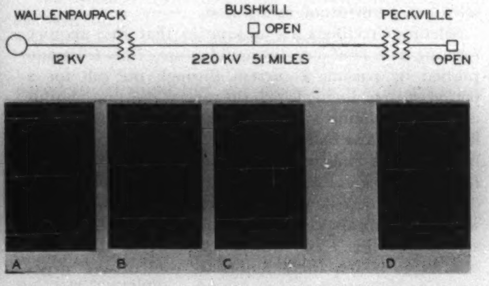


**Fig. 7. Transient analyzer oscillograms of steady-state wave shape, with 220-kv Bushkill–Peckville line energized from Wallenpaupack at 60 cps. Peckville transformers connected to line. *A.* Generator internal voltage, 140%. *B.* Generator 12-kv terminal voltage. C. Wallenpaupack 220-kv voltage. D. Peckville 220-kv voltage.**

### CONCLUSIONS

1. The breaker at Bushkill would not drop the 220-kv line alone without multiple restriking. During each of the seven line-dropping operations on December 2, 1956, there were three or four restrikes in each phase. These restrikes caused permanent damage to the breaker interrupters.
2. Analyzer tests indicate that resistors can control restrike voltage magnitudes effectively, and thus prevent overvoltage damage to other electrical apparatus.
3. The lightning arresters at Peckville were destroyed by cumulative heating resulting from repetitive discharge of switching-surge and power-follow currents.
4. Investigation by the electrical industry is needed to determine the effects on arrester life, protective characteristics, surge impedance, sparkover values, and reseal voltages when discharging successive switching-surge and follow-current loops. The switching-surge and follow-current loops should be timed to correlate with the widely used breaker reclosing cycle of open–20 cycles–close open–15 seconds–close open–1 minute–close open, with a minimum of two successive restrikes for each breaker opening.
5. It is desirable to switch a line and a grounded-Y power transformer as a unit where convenient, because the transformer will dissipate the energy trapped on the line and reduce the recovery voltage to which the breaker is subjected.

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2. Switching Surge Voltages in High-Voltage Stations, I. B. Johnson, A. J. Schultz. AIEE *Transactions*, vol. 73, pt. III-A, Feb. 1954, pp. 69-79.

3. Transient Performance of Electric Power Systems (book), R. Rudenberg. McGraw-Hill Book Company, Inc., New York, N.Y., chapters 52, 53.

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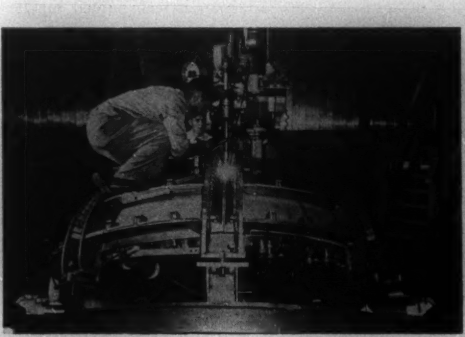
## Building the Titan ICBM

A special fixture holds "orange-peel" aluminum sections as they are automatically joined by Heliwelding, an inert gas arc-welding process. These sections form part of the fuel tank for the Titan, an intercontinental ballistics missile being built by the Martin Company, Denver, Colo., for the U. S. Air Force. Air Reduction Company (in conjunction with subcontractors) designed and engineered fixtures, rotating devices, loading mechanisms, and other parts of the welding machine tool, such as welding heads, remote controls, and power sources. It is the largest precision welding tool installation ever engineered in this country, and was handled by Airco's Machine Welding Department, a group specializing in such work.



# Metallic Rectifiers for Shipboard Electric Systems

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**The development of metallic rectifiers has resulted in the increased use of rectifiers in the place of motor–generators as d-c power sources on ships having a-c plants. The characteristics, applications, and advantages of these rectifiers are discussed.**

PRIOR TO 1932, all U.S. Navy ships had d-c electric plants for supplying power to electric auxiliaries and lighting systems. As the size of electric plants grew, it was recognized that the adoption of a-c systems for shipboard electric plants offered distinct advantages. At the present time, all of the newer Navy shipboard electric generating plants, except for some small ships, are designed to provide 450 volts a-c. However, some electric auxiliaries used on board ship require direct current for their operation. Direct current is needed for such applications as degaussing, battery charging, carbon-arc searchlights, generator excitation, circuit breaker and reactor control circuits, cathodic protection, guided-missile servicing, aircraft starting and servicing, etc.

Until 1951, d-c power was provided from a central source and distributed through a section of the ship service switchboard. The d-c power was provided by using either motor–generator sets or oversized exciters on the a-c generators. Thus, on ships with a-c power plants, a complete d-c power generation and distribution system was provided that was analogous to the a-c power system.

The development of metallic rectifiers has resulted in the applications of rectifiers in the place of motor–generators as d-c power sources on ships with a-c power plants. Rectifiers are now being used as d-c power sources on the Forrestal class aircraft carriers, guided missile destroyers, and other ships.

## METALLIC RECTIFIER CHARACTERISTICS

A METALLIC RECTIFIER (also called a semiconductor rectifier) is a static device which exhibits a high resistance to the flow of current in one direction and a very low resistance to the flow of current in the other direction. In general, it consists of a rectifying material sandwiched between two electrodes. When connected to proper circuitry, it converts alternating current into direct current.

In the last 10 years, the work of many physicists has brought forth a better understanding of the mechanism of rectification which has resulted in rectifier cells of higher voltage, higher temperature operation, and generally improved performance. The most important metallic rectifying materials at the present time are selenium, germanium, and silicon.

Selenium rectifiers are unique in that they require forming as a final step in manufacture. This is accomplished by passing a current through the cell for a period of time during which the reverse resistance builds up to a maximum value. Conversely, a selenium rectifier tends to lose its high reverse resistance when standing idle for a long period of time. However, it rapidly regains its original reverse resistance when re-energized.

When subjected to small overvoltage surges, the weaker spots in the cell tend to burn out, but these spots are "self-healing," and the performance of the cell is not seriously impaired. Similarly, overcurrent surges cause momentary heating, but the cell has sufficient thermal capacity to absorb these surges without serious damage.

Selenium rectifiers are subject to aging with use, causing an increase in forward resistance. This shows up as a decrease in output voltage and design provisions (such as transformer taps) must be made to compensate for this effect.

A selenium rectifier is said to have finished its useful life when its forward resistance has doubled. When the cell temperature is kept below 75 C, a life of about 80,000 hours is obtained. Higher operating temperatures shorten the life, so that with a maximum cell temperature of 150 C (ambient 130 C) the life is about 1,500 hours without derating.

Modern selenium cells withstand a continuous peak inverse voltage of 63 volts. The efficiency of a selenium transformer–rectifier may be as high as 85%. The losses in the rectifier cells may be handled with convection cooling, but a two- or threefold reduction in size may be obtained with forced-air cooling, depending on the rating. This is particularly true for rectifiers rated 50 to 100 kw. As the result of long experience and mass production methods, selenium rectifiers generally have been found less expensive than germanium or silicon.

Germanium rectifiers are comparatively new, with application experience in the power field dating back only about 5 years. If kept below 75 C they are stable and show no aging effects. Because of the high current density at which they operate, they are very small com-

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Full text of paper 58-135, presented at the AIEE Winter General Meeting, New York, N. Y., Feb. 2-7, 1958. Recommended for publication by the AIEE Marine Transportation Committee. Scheduled for publication in AIEE *Applications and Industry*, 1958.

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**Table I. Comparison of Rectifier Properties**

| Property | Selenium | Germanium | Silicon |
|---|---|---|---|
| Maximum peak inverse voltage per cell | 63 | 100 | 300 |
| Maximum operating cell temperature | 75 C* | 75 C | 200 C |
| Maximum d-c output voltage per cell† | 54 | 80 | 275 |
| Forward current density amperes, per square inch† | 1.2 | 1000 | 3000 |
| Forward drop voltage at above density | 1.2 | 0.7 | 1.3 |
| Typical regulation, new | 10% | 5% | 5% |
| Typical regulation, aged | 15% | 5% | 5% |
| Cell failure protection required | no | yes | yes |
| Typical efficiency, transformer and rectifier | 85% | 94% | 94% |

* For 80,000 hour life

† For 3-phase full-wave bridge circuit, forced-air cooled

pared to selenium but, for the same reason, they are destroyed by overvoltage or overcurrent surges. Considerable attention must be given to the cooling of germanium cells because the losses are concentrated in such a small area. The extremely high reverse resistance makes germanium rectifiers very attractive for magnetic amplifier applications. The reverse current is so small that, even though it varies with temperature, it has negligible resetting effect on magnetic amplifier cores in many applications.

Currently, the maximum continuous peak inverse voltage for germanium cells is about 100 volts at a cell temperature of 75 C. The efficiency of a germanium transformer–rectifier may be as high as 94%.

Silicon rectifiers are quite new, and have properties resembling those of germanium. Their outstanding differences are a much higher peak inverse voltage (300 volts), a much higher maximum operating temperature (200 C) and a maximum current density several times as great as germanium. The maximum efficiency is about the same as for germanium. Cooling means are even more important than with germanium because of the even greater concentration of losses. Silicon rectifiers are also well adapted to magnetic amplifier applications, especially where high-temperature operation is required.

Table I compares the properties of selenium, germanium, and silicon rectifiers. These values should be considered typical rather than limiting. It is not always possible to realize all values that are given in Table I in a specific design.

## RECTIFIER APPLICATIONS

WHERE RECTIFIERS ARE USED, it is the practice to provide a rectifier for each d-c load or auxiliary and install it in the vicinity of the equipment for which it is designed.

Some typical applications of metallic-rectifier power supplies are as follows:

*Degaussing*. A degaussing system is installed aboard ship to minimize the possibility of the ship's actuating a magnetic firing device such as those used in magnetic mines and magnetic torpedoes. This system consists of one or more coils of electric cable wound in a specific location inside the ship's hull. A direct current is passed through these coils which produces countermagnetic fields that are at all times equal in magnitude but opposite in polarity to the ship's fields. The magnitude and polarity of the current are controlled by auxiliary equipment which is operated either manually or automatically. Degaussing coil power supplies have 440-volt 60-cycle a-c power inputs and d-c outputs. Rectification in the power supply is accomplished by means of selenium rectifiers. The magnitude of the output current is controlled by magnetic amplifiers. A ventilating fan usually provides cooling for the rectifier bank. Degaussing power supplies range from 3 to 40 kw, depending on the degaussing coil and size of ship. For a recent class of Navy oilers, the ratings of the degaussing power supplies are 7.2 kw, 25.4 kw, and 40 kw for the various degaussing coils. The rectifier power supply for one of the coils is shown in Fig. 1.

*Aircraft Servicing and Starting*. The primary function of the deck edge low-voltage electric system found on most types of modern aircraft carriers is to provide a readily accessible source of servicing and starting power to jet aircraft at almost all locations on the carrier's flight deck. Servicing power from 25 to 29 volts d-c is used to warm up and checkout the aircraft's electronic equipment and other vital equipment before take-off. It also is required for routine test and maintenance of various items of aircraft equipment.

Modern aircraft require approximately 1,100 amperes, 33 volts d-c for starting jet engines.

Low-voltage d-c power for aircraft servicing and starting is obtained from specially designed rectifier power supplies. One of the aircraft servicing and starting rectifier power supplies for an aircraft carrier is shown in Fig. 2. These power supplies are designed to maintain

Courtesy Vickers Electric Division

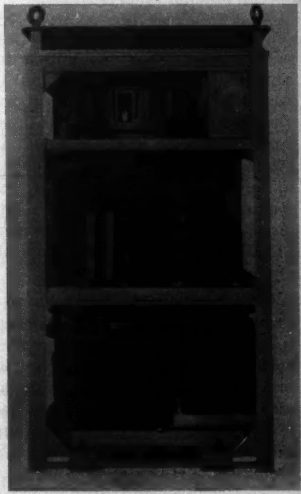


**Fig. 1. Degaussing power supply, 24.5 kw.**

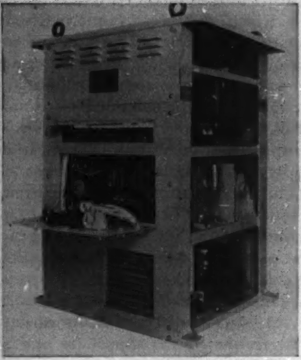


**Fig. 2. Jet aircraft servicing and starting power supply.**

*Courtesy General Electric Company*

constant voltage at the servicing terminals regardless of the load (from 0 to 600 amperes). Current to jet engine starting motors is held between 1,000 to 1,100 amperes by magnetic amplifier regulators, with a finishing voltage of approximately 33 volts d-c.

*Static Excitation Systems.* Static excitation systems are being furnished for some ships service and emergency generators. Minesweepers, some nuclear-powered submarines, and the 400-cycle turbine–generator sets on aircraft carriers have static excitation systems. In these systems, direct current for generator field excitation is provided by selenium or silicon rectifiers. The rectifiers are either mounted remote from the generator or are mounted on the generators so that they can be cooled with air circulated by the generator fan. A view of a typical static excitation system rectifier assembly mounted on top of a turbine–generator in the air cooler is shown in Fig. 3.

*Magnetic Amplifiers.* Voltage regulator and various control applications are being accomplished with the use of magnetic amplifiers. Magnetic amplifiers usually employ rectifiers as circuit elements in conjunction with saturable reactors. Rectifiers will actually pass a small (leakage) current in the reverse direction. Leakage current in magnetic amplifiers results in desaturating the core and lowering the gain of the amplifier circuit. Because of this, rectifiers with low leakage currents are required for magnetic amplifiers. In addition to being used for voltage regulation, magnetic amplifiers have found wide application in control circuits, such as nuclear reactor instrumentation.

*Electronics.* Metallic rectifiers have completely changed the concept of d-c power supply design. Where it had previously been considered impractical to use voltage multiplier circuits because of the complexity in supplying filament power, rectifiers are now in common use. Voltage multipliers using metallic rectifiers eliminate the need for power transformers and rectifier tubes.

*Cathodic Protection Systems.* Shipboard cathodic protection installation supplements the paint coating in preventing corrosion of the underwater hull and its appendages. Protection against corrosion is achieved by eliminating the potential difference between anodic and cathodic areas. A cathodic protection system is a closed-loop system in which a power supply produces a current flow from isolated anodes through the sea water to the ship's hull in a quantity such that the hull potential remains essentially constant at a predetermined optimum value. The Bureau of Ships is obtaining prototype automatically controlled d-c power supplies for use in cathodic protection systems. Metallic rectifiers will be used in these power supplies.

*Small Boat Generators.* In general, small landing craft and boats are provided with d-c generators, belt driven from the propulsion engine. At low propulsion engine speeds, the d-c generators are not capable of supplying power. With increased electrical loads and the addition of electronic equipment on small landing craft and boats, it is necessary to supply power over the complete propulsion engine speed range in order to prevent the boat's storage battery from becoming discharged. To meet these requirements, an alternator rectifier was developed for Navy use. The first alternators used selenium rectifiers for converting the 3-phase alternating current to direct current. Propulsion engine intake air was used for cooling the rectifiers. This was a satisfactory electrical installation. However, it required modification of the air intake manifold on the diesel propulsion engine so that the rectifier assembly could be accommodated. To overcome this difficulty, the manufacturer developed a 2,000-watt 28.5-volt d-c alternator rectifier using silicon rectifiers as shown in Fig. 4. Because of their small size, the silicon rectifiers are mounted inside the generator enclosure. This type of rectifier installation permits blast cooling of the rectifiers by means of air supplied by the generator cooling fan. An alternator rectifier of this type was evaluated successfully and is being specified for recent small boat programs.

*Battery Charging.* Metallic-rectifier power supplies are used aboard ship for charging the various storage batteries installed for engine starting, portable flood

*Courtesy Westinghouse Electric Corporation*

**Fig. 3. Static excitation system mounted in the air cooler of an 800-kw turbogenerator set for a nuclear-powered submarine.**

lanterns, etc. The rectifier power supply is part of the battery-charging switchboard which is arranged to charge the various batteries at either local or remote stations. Batteries range from 2 to 24 volts.

*Circuit Breaker Control.* Metallic rectifiers are used to convert the a-c control source to direct current which is required by the closing coil of electrically operated circuit breakers. Selenium rectifiers are used, although recently the Navy has authorized the use of silicon rectifiers for this purpose.

In addition to the aforementioned applications, rectifiers are being used in the power supplies for guided missile servicing and carbon-arc searchlights.

One of the largest rectifier installations on board ship is that for the stern anchor winch on a new class of landing ships. This power supply is rated at 100 kw.

### METALLIC RECTIFIERS VS MOTOR–GENERATOR SETS

IN THE SELECTION of a d-c power supply, factors which should be considered include application, reliability, maintenance, size, weight, cost and efficiency. An analysis of the advantages and disadvantages of metallic rectifiers vs motor–generator sets is presented in the following tabulation:

| Characteristic | Motor—Generator | Rectifier |
|---|---|---|
| Light-load operation | B | A |
| Reliability | B | A |
| Maintenance | B | A |
| Size | B | A |
| Weight | B | A |
| Cost | B | A |
| Control | B | B |
| Overload | B | B |
| Radio interference | B | A |
| Quiet operation | B | A |
| Efficiency | B | A |
| Output fixed voltage | B | A |
| Output variable voltage | A | B |

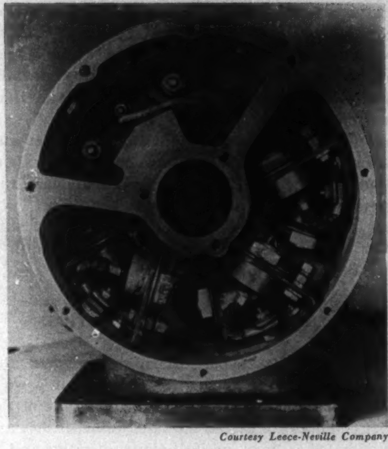
A = Superior B = Suitable

Metallic rectifiers have a decided advantage when operating at light loads because there is no decrease in life and their efficiency is high. Compared to this, motor–generator sets have certain disadvantages. Running motor–generator sets at light loads tends to destroy the film on the commutator which, in turn, produces brush wear and some brush chatter. This adds to maintenance expense in that the commutator may become rough. Also, the efficiency of motor–generator sets is quite low at light loads. On this basis, the rectifier is more suitable for light load applications.

Maintenance time and expense for metallic rectifiers are much less than for rotating equipment, inasmuch as there are no moving parts except, in some cases, a cooling fan. Inherently, rotating machines require more maintenance.

**Table II. Comparison of Selenium Rectifier and Motor–Generator Installations**

| | Central Motor–Generator Installation | Selenium Rectifier Installation |
|---|---|---|
| Cost | 100% | 40 to 50% |
| Weight | 100% | 50 to 60% |
| Volume | 100% | 60 to 70% |



*Courtesy Leece-Neville Company*

**Fig. 4. End view of 2,000-watt alternator rectifier showing silicon rectifier installation.**

A comparison between a motor–generator and a metallic-rectifier installation was made for a recent class of minesweepers and escort vessels in order to show the weight, space requirements, and cost of either installation. For the rectifier installation, power supplies were provided at the individual loads. For the motor–generator installation, a central d-c system was used. Table II shows this comparison.

The savings indicated in Table II result, to a great extent, from the fact that the rectifier installation does not provide for two separate power sources, as is done in the case of motor–generator sets. The rectifier, being a static device, has no moving parts which require servicing, whereas the motor–generator requires frequent inspection and servicing. To permit this servicing, a standby motor–generator set is provided so that a d-c power supply is always available.

On a ship basis, the use of individual metallic rectifiers in lieu of a central motor–generator set for direct current power supplies has resulted in substantial savings in cost, weight, and space as noted in Table II. Also, the use of rectifiers has reduced the cable requirements and the number of bulkhead penetrations since long runs of cables carrying direct current have been omitted. Inasmuch as rectifiers are dispersed throughout the ship, most of the space and weight savings take place in the generator or engine room where space is at a premium. With the further development and application of silicon and germanium rectifiers, the weight and space requirements will be reduced further.

Another advantage of metallic-rectifier power supplies is that they do not require special foundations. Rectifier units can be mounted on the deck or bulkhead without any difficulty whereas motor–generator sets must be provided with foundations which will assure proper alignment of the motor–generator set.

If adjustable voltage direct current is required over a wide range, the motor–generator set is probably the best conversion means. However, rectifier power supplies can be made to provide adjustable voltage by using saturable reactors or induction voltage regulators in the alternating current input voltage.

Metallic rectifiers have the advantage of quiet and vibrationless operation. They are simple and inexpensive to install, operate reliably unattended, and have low maintenance and high momentary load capacity.

Also, the use of metallic rectifiers on board ship reduces the number of spare components required because of their reliability.

## INSTALLATION AND OPERATING FEATURES

METALLIC RECTIFIERS, particularly the selenium and germanium type, are designed for operation in a well-ventilated location so that the total temperature of the rectifier cell does not exceed the rated value. If they are to be operated at their specified electrical rating and if the desired reliability and low maintenance are to be expected, adequate ventilation should be provided.

Rectifier power supplies for shipboard applications are normally designed for use in 50 C ambient temperatures. Installation activities have the responsibility of seeing that rectifier power supplies are located in surroundings where the ambient temperature is compatible with the equipment design ambient.

When a location for rectifier power supplies is being chosen, the following factors should be considered, in order that the heat from the rectifiers may be dissipated promptly:

1. Equipment containing metallic rectifiers should be located in the coolest available place close to the power-consuming equipment.
2. The location selected should not be downstream from other equipment that dissipates much heat.
3. The heated air should move away from the area selected; that is, stagnant air spaces or immediate recirculation of the heated discharge air should be avoided.
4. Fan-cooled and ventilated rectifier equipment should be so oriented that the intake air comes from the cooler direction and the discharge is toward the warmer region as well as in line with the direction of exhaust from the space.
5. Natural baffling should be used to the best advantage, and consideration should be given to arrangement and orientation of all equipment in the space to get the best circulation of air.
6. The placing of metallic rectifiers in confined spaces should be avoided. Hot air may be trapped in such spaces and tends to accumulate at the top of a space. If such a location cannot be avoided, and other things are equal, the rectifiers should be placed low in the space, rather than high, but they should be above any bilge water splash level.
7. Equipment containing metallic rectifiers should not be placed adjacent to or in the immediate vicinity of other equipment that operates at temperatures appreciably higher than ambient temperature, nor should it be placed near any surface that is likely to reach high temperature.
8. Rectifier cells and stacks should not be painted or varnished.
9. Care should be taken that the ambient temperature to which the equipment was designed is not exceeded.
10. Maintenance procedures should include an examination of equipment air openings and passages to make sure air flow has not been reduced by dust accumulation or by clogging of passages with foreign objects.

Regenerative d-c loads can have serious effects on rectifier power supplies unless the necessary precautions are taken. Loads which return power to the d-c system during some part of their operating cycle are known as regenerative. A rectifier will not absorb energy from the d-c bus. If there is nothing connected to the bus which will absorb power, a regenerative load will cause an increase in d-c bus voltage, which could injure the rectifier stacks as well as cause a malfunctioning of the load which is regenerating.

Regeneration is of no concern if other nonregenerative loads capable of absorbing the regenerated power are always connected to the d-c bus. Fans and blowers are common loads of this type.

If other loads cannot be relied upon to absorb regenerated power, protective equipment must be provided to absorb it. In cases where regeneration is very frequent, and the power involved is small compared with the rectifier rating, a fixed resistor connected permanently to the d-c bus may be the most economical solution. In most cases, the power regenerated is sufficiently large to make it desirable to provide special switching equipment to connect an absorbing resistor to the bus only when regeneration occurs. Dynamic braking protective equipment may be used for this purpose.

## FUTURE TRENDS

THE INCREASING USE of magnetic amplifiers is turning the spotlight on germanium and silicon. Research and engineering are continually rolling back the limitations on these two new materials. Increasing acceptance by industry will inevitably reduce the cost until germanium and silicon may well dominate the metallic-rectifier field. However, the greater ruggedness and somewhat simpler application problems will enable selenium to retain its present leadership in many fields where maximum efficiency and high temperature operation are not mandatory. For shipboard applications, the shock and vibration resistance and lack of maintenance requirements may well result in the practical monopoly by metallic rectifiers of all a-c to d-c power conversion requirements.

# Leakage-Flux Suppression in Magnetic Air Breakers

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THE MAGNETIC AIR CIRCUIT BREAKER, during the past two decades, has become a most effective and widely used circuit-interrupting device. The need for increased ratings in magnetic air circuit breakers has required critical studies of and improvements in the various factors involved in the interrupting process in these devices. One important factor, the magnetic field, has been improved in a number of ways, but the inherently large leakage flux has not been appreciably affected by these improvements. Studies made on such a-c energized magnetic field structures indicated that the total leakage flux was 50% or more of the total flux emerging from the magnet core.

In order to permit the study of the magnitudes of useful and leakage flux, as well as the distribution of flux density in the air gap of the magnet structures, search coils were introduced in such a manner that the flux to be measured linked the probe coil. The integral with respect to time of the voltage generated in such a probe is proportional to the flux linking the coil.

Although it is quite possible to integrate graphically the voltage trace from an oscillogram and, thus, plot the instantaneous flux curve, this is not necessary because electrical integrating circuits are available that will perform this integration and record the instantaneous flux curve directly on a magnetic oscillogram or the screen of a cathode-ray tube.

Through the use of such methods, the effects of changes and improvements in field structures may readily be studied. A typical field structure similar t one used in a 500-mva 15-kv magnetic air circui breaker is shown in Fig. 1. The magnet is shown with a experimental 4-plate arc chute in the air gap, an with leakage suppressor bands surrounding the pol faces.

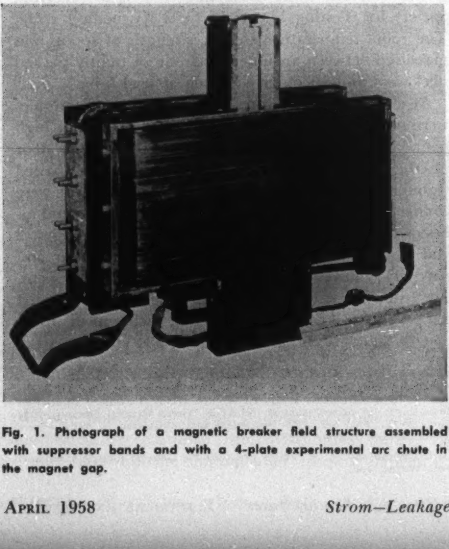

Fig. 1. Photograph of a magnetic breaker field structure assembled with suppressor bands and with a 4-plate experimental arc chute in the magnet gap.

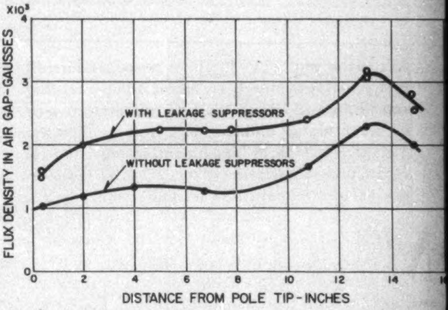

Fig. 2. Flux densities midway between poles in a magnetic air breake field at 15,400 amperes rms, with and without leakage suppressor bands

The inherently large leakage flux in such a magne can be reduced substantially by the use of leakage sup pressor bands as shown in Fig. 1. These are heavy cop per conductors completely surrounding each of th magnet pole faces in such a manner that the leakag flux emerging from the back sides of the poles mus link the bands, but the useful flux passing between th inner pole faces does not link them. Current generate in the closed bands by the alternating flux thus tend to suppress the leakage flux. Inasmuch as there i less leakage, more useful flux can enter the field pole and gap before saturation of the poles occurs.

As shown in Fig. 2, increases in useful flux up t about 75% were observed when leakage suppressor were added to the field structure shown in Fig. 1. Suc leakage suppressors, if used without redesign of th interrupter chute, increase the useful flux to the exten that the arc reaches the top of the chute too quickly However, with properly designed arc chutes, highe current arcs can be stretched to greater lengths and suc cessfully interrupted in this increased field. The appli cation of these bands to various types of magneti breakers has produced substantial increases in inter rupting capacities.

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Digest of paper 58-21, "Suppression of Leakage Flux in Magnetic Ai Breakers," recommended by the AIEE Switchgear Committee and ap proved by the AIEE Technical Operations Department for presentatio at the AIEE Winter General Meeting, New York, N. Y., Feb. 2-7, 195 Scheduled for publication in AIEE *Power Apparatus and Systems*, 195

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# Electrical Insulation Properties at Ultrahigh Temperatures

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M. M. FELGER

**The era of high-speed nuclear propelled aircraft and missiles demands electronic equipment that can withstand intense nuclear radiation as well as much higher ambient temperatures than the 125 C required of equipment in current use. Major technological advances must be made in design and manufacture to realize these goals.**

MATERIALS ultimately set the limits on how high a temperature and radiation intensity the components and equipment can be designed for and still perform their assigned function. For electronic transformers, three essential materials are coil insulation (sheet and spool), insulated wire, and magnetic iron core. In this article are presented the results of a U. S. Air Force sponsored investigation to determine the effects of 500 C temperature on sheet and spool insulations for electronic transformers. The effects of radiation on these materials was not a part of this investigation. Materials selected for evaluation are shown in Table I.

Because the sheet insulations would have to withstand winding into coils, the following initial physical properties were measured: (1) elongation, (2) flexibility, and (3) tensile strength.

The specified thermal life of the coil insulations was 1,000 hours in a maximum ambient temperature of 500 C. It was estimated that the temperature rise of the transformers in which the insulation would be used would be about 100 C. This would bring the total temperature up to 600 C. To determine the effects of the ultrahigh temperatures on the coil insulations, electrical properties were measured at test temperature and after heat aging. The test temperatures selected were 300 C, 400 C, 500 C, and 600 C. One thousand (1,000) hours and 600 C were selected for the heat aging conditions. The electrical properties picked to be measured were: (1) electrical strength, (2) volume resistivity, (3) dissipation factor at 100 and 1,000 cycles per second (cps), and (4) dielectric constant at 100 and 1,000 cps.

**Table I. Materials Selected for Evaluation**

| Material | Thickness, mils |
|---|---|
| *Sheet Insulation* | |
| Aluminum silicate paper | 10 and 20 |
| Asbestos paper, silicone impregnated | 3 |
| Glass paper | 4 |
| Integrated phlogopite mica, silicone bonded | 2-3 |
| Quartz fiber cloth | 4 |
| Recombined muscovite mica paper, silicone bonded | 4 |
| Recombined muscovite mica paper—glass cloth, silicone bonded | 4 |
| *Spools* | |
| Recombined muscovite mica paper, aluminum phosphate bonded | 31-35 |
| Recombined muscovite mica paper, silicone bonded | 23-28 |
| Steatite | 37 |

### PHYSICAL PROPERTIES

ELONGATION AND TENSILE STRENGTH were measured on a standard constant speed crosshead tensile machine. Flexibility was determined by a 180° bend over a 1/8 inch mandrel.

Table II gives the initial physical properties of layer insulation. All of these materials have relatively low tensile strength and elongation, but the better ones can be fabricated into coils with proper handling.

Table III gives the condition of all materials after 1,000 hours at 600 C. The silicone bonded recombined mica had the best thermal resistance. Fig. 1 shows the physical condition of all materials after aging 1,000 hours at 600 C.

### ELECTRICAL STRENGTH

THE INITIAL ELECTRICAL STRENGTH of materials at room conditions have little value for materials used at ultrahigh temperatures. Therefore, this property was determined after various thermal treatments at the treatment temperatures. One condition was an initial aging of 40 hours to drive off any volatile or easily decomposable materials.

The initial dielectric strength at room temperature for flat insulation was measured according to American Society for Testing Materials (ASTM) method *D149*. The room temperature electric strength of spools was measured between an inner electrode of tightly packed steel wool and an outer electrode of lead foil.

At elevated temperatures, the electrodes and samples were mounted on a sliding frame with a door of high temperature asbestos board replacing the regular door of the furnace. The electrode connections passed through holes in the door without touching and were connected by flexible leads to terminals in a second asbestos board mounted 6 inches from the door. Figs. 2 and 3 show the electrode assembly from the rear and partially removed from the furnace. This arrangement, prevented current leakage through the door at elevated temperatures. The electrodes were 2 inches in diameter and of standard shape made from 304 stainless steel.

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Essentially full text of paper 58-115, recommended by the AIEE Dielectrics Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Winter General Meeting, New York, N. Y., Feb. 2-7, 1958. Scheduled for publication in AIEE *Power Apparatus and Systems*, 1958.

G. I. Duncan and M. M. Felger are with the General Electric Company, Fort Wayne, Ind.

**Table II. Initial Physical Properties of Ultrahigh Temperature Layer Insulation**

| Layer Insulation | Thickness Mils | Tensile Strength pounds per inch width | Elongation Per Cent | Flexibility ⅛ inch mandrel, 180° bend |
|---|---|---|---|---|
| Aluminum silicate paper, source A | 17.3 | 0.32 | 0.76 | satisfactory |
| Aluminum silicate paper, source B | 12.2 | 0.30 | 0.7 | satisfactory |
| Asbestos paper, silicone impregnated | 3.0 | 9.5 | 1.3 | satisfactory |
| Glass paper | 3.3 | 2.4 | 0.55 | satisfactory |
| Integrated phlogopite mica, silicone bonded | 2.7 | 11.2 | 0.25 | satisfactory |
| Quartz fiber cloth | 3.5 | 2.2 | 1.1 | satisfactory |
| Recombined muscovite mica paper, silicone bonded | 4.1 | 11.1 | 0.42 | satisfactory |
| Recombined muscovite mica paper—glass cloth, silicone bonded | 5.3 | 2.71 | 2.3 | satisfactory |

**Table III. Physical Condition of Ultrahigh Temperature Insulation after 1,000 Hours at 600C**

| Material | Condition |
|---|---|
| *Layer Insulation* | |
| Aluminum silicate paper (10 mils) | Little change |
| Asbestos paper, silicone impregnated | Complete failure by physical disintegration. |
| Glass paper | Complete failure by physical disintegration. |
| Integrated phlogopite mica, silicone bonded | Little change, except decrease in flexibility. |
| Recombined muscovite mica paper, silicone bonded | Considerable loss of flexibility; 50% increase thickness. |
| Recombined muscovite mica paper—glass cloth, silicone bonded | Glass cloth disintegrated; complete failure. |
| *Spool Material* | |
| Recombined muscovite mica paper, aluminum phosphate bonded | Increased in thickness 40%; otherwise good condition. |
| Recombined muscovite mica paper, silicone bonded | Brittle and delaminated. |
| Steatite | No observable change. |
| *Spools* | |
| Recombined muscovite mica paper, aluminum phosphate bonded | Good condition. |
| Recombined muscovite mica paper, silicone bonded | Badly delaminated. |
| Steatite | Good condition. |

Stainless steel leads with a right-angle bend came through the false door openings.

The electric strength measurements of spools were made at elevated temperature in the furnace on the sliding frame. Stainless steel wool was the inner electrode. The outer electrode was a 1-inch wide conducting ceramic band.

Fig. 4 shows the circuit used for measuring electric strength at elevated temperatures. Failure was indicated by a sudden increase of current on the vacuum tube voltmeter.

However, on some materials, only a limiting value could be obtained because of small sample size or increased conductance at the elevated temperatures. The materials that showed high conductance were silicone bonded recombined muscovite mica, aluminum phosphate bonded recombined muscovite mica paper, glass paper and steatite.

The results are given in Table IV. The best retention of electric strength by layer insulations was obtained with silicone bonded integrated phlogopite mica and silicone bonded recombined muscovite mica paper. Three materials, silicone impregnated asbestos paper, glass paper, and silicone bonded recombined muscovite mica–glass cloth–failed physically. The best spool material was aluminum phosphate bonded recombined muscovite mica, even though it increased in thickness during aging.

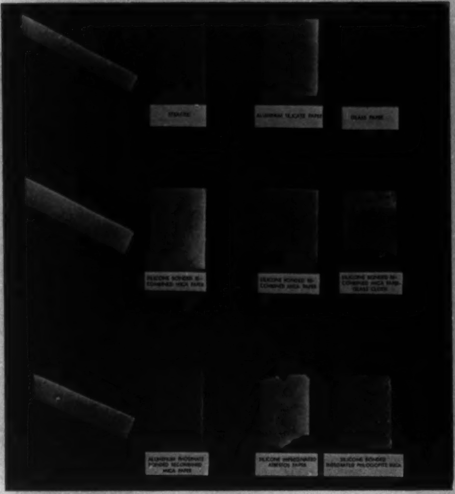

STEATITE
ALUMINUM SILICATE PAPER
GLASS PAPER
SILICONE BONDED RE-COMBINED MICA PAPER
SILICONE BONDED RE-COMBINED MICA PAPER
SILICONE BONDED RE-COMBINED MICA PAPER-GLASS CLOTH
ALUMINUM PHOSPHATE BONDED RECOMBINED MICA PAPER
SILICONE IMPREGNATED ASBESTOS PAPER
SILICONE BONDED INTEGRATED PHLOGOPITE MICA

**Fig. 1. Visual inspection after 1,000 hours at 600 C.**

## INSULATION RESISTANCE

THE MEASUREMENTS of this property were made with the same electrode and furnace assembly as described for electric strength. The electrode area was 2.4 square inches. Resistance was measured with a General Radio megohm bridge, type *544B*, at 100 volts d-c. These values were then calculated to volume resistivity and are given in Table V.

In all theories of conduction through insulations, it is assumed that the charge-carrying entity (electron, hole, or ion) must overcome some energy barrier in

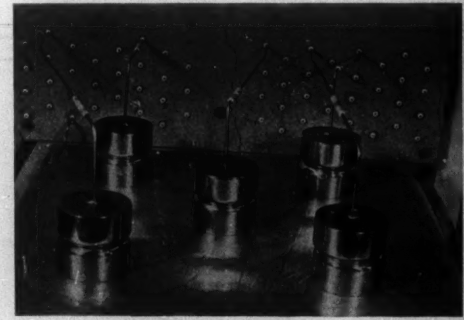


**Fig. 2. Electric strength electrode assembly.**

### Table IV. Electric Strength of Ultrahigh Temperature Insulation

| Material | Nominal Thickness Mils | Initial Electric Strength Volts per mil | Electric Strength (Volts per mil) After Initial Aging | | | | Electric Strength after 1,000 hours at 600C Volts per mil |
|---|---|---|---|---|---|---|---|
| | | | 40 hours at 300C | 40 hours at 400C | 40 hours at 500C | 40 hours at 600C | |
| *Layer Insulation* | | | | | | | |
| Integrated phlogopite mica, silicone bonded | 2-3 | 440 | 260 | 280 | 260 | 280 | 296 |
| Aluminum silicate paper (A) | 10 | 233 | 114 | 106 | 97 | 112 | 105 |
| Aluminum silicate paper (B) | 20 | 176 | 96 | 83 | 86 | 88 | 86 |
| Asbestos paper, silicone impregnated | 3 | 410 | 270 | 330 | 290 | 280 | Brittle |
| Glass paper | 4 | 200 | 175 | 160 | 145 | 77 | Disintegrated |
| Recombined muscovite mica paper, silicone bonded | 4 | 390 | 390 | 455 | 485 | 455 | 330 |
| Recombined muscovite mica — glass cloth, silicone bonded | 4-5 | 350 | 260 | 285 | 270 | 240 | Glass brittle |
| Quartz fiber cloth | 4 | 147 | 134 | 128 | 124 | — | — |
| *Flat Spool Material* | | | | | | | |
| Recombined muscovite mica paper, silicone bonded | 23-28 | >800 | >300 | >300 | >300 | >300 | >300 |
| Recombined muscovite mica paper, aluminum phosphate bonded | 31-35 | >700 | * | * | * | >50 | >50 |
| Steatite | 57 | † | † | † | † | † | † |
| *Spools* | | Total Volts | | | | | |
| Recombined muscovite mica paper, silicone bonded | | 12,000 | 7,900 | 7,600 | >6,000 | >4,800 | >3,700 |
| Recombined muscovite mica paper, aluminum phosphate bonded | | 19,000 | >12,600 | >8,300 | >8,700 | >6,700 | >2,700 |
| Steatite | | >25,000 | >12,600 | >6,200 | >3,800 | >2,800 | >3,000 |

* Samples too small for measurement.
† Samples not available.

### Table V. Volume Resistivity of Ultrahigh Temperature Insulations

| | Condition | | | | | |
|---|---|---|---|---|---|---|
| | As Received | 40 hours at 300C | 40 hours at 400C | 40 hours at 500C | 40 hours at 600 C | 1,000 hours at 600C |
| | Measured at | | | | | |
| Material | 25C | 300C | 400C | 500C | 600C | 600C |
| *Layer Insulation* | | | | | | |
| Aluminum silicate paper (A) | $3.9\times10^{12}$ | $4.4\times10^{12}$ | $3.3\times10^{11}$ | $1.9\times10^{10}$ | $6.6\times10^{9}$ | $2.1\times10^{9}$ |
| Integrated phlogopite mica, silicone bonded | $3.3\times10^{13}$ | $6.0\times10^{13}$ | $8.1\times10^{12}$ | $3.3\times10^{11}$ | $7.3\times10^{10}$ | $1.0\times10^{10}$ |
| Asbestos paper, silicone impregnated | $1.9\times10^{13}$ | $1.7\times10^{14}$ | $3.1\times10^{13}$ | $9\times10^{11}$ | $2.0\times10^{11}$ | * |
| Glass paper | $3.8\times10^{12}$ | $8.0\times10^{10}$ | $9.5\times10^{9}$ | $4.1\times10^{9}$ | $6.0\times10^{8}$ | * |
| Recombined muscovite mica paper, silicone bonded | $1.4\times10^{13}$ | $6.2\times10^{12}$ | $3.8\times10^{11}$ | $5.4\times10^{10}$ | $1.5\times10^{10}$ | $6.5\times10^{9}$ |
| Recombined muscovite mica — glass cloth, silicone bonded | $3.9\times10^{14}$ | $8.7\times10^{13}$ | $2.6\times10^{12}$ | $3.0\times10^{11}$ | $8.6\times10^{10}$ | * |
| Aluminum silicate paper (B) | $8.3\times10^{12}$ | $8.4\times10^{13}$ | $5.3\times10^{11}$ | $3.8\times10^{10}$ | $6.8\times10^{9}$ | $1.4\times10^{9}$ |
| Quartz fiber cloth | $3.4\times10^{9}$ | $4.2\times10^{12}$ | $1.9\times10^{11}$ | $3.5\times10^{10}$ | $3.1\times10^{9}$ | |
| *Flat Spool Material* | | | | | | |
| Recombined muscovite mica paper. silicone bonded | $4.2\times10^{13}$ | $1.1\times10^{13}$ | $6.7\times10^{11}$ | $6.8\times10^{10}$ | $1.5\times10^{10}$ | $5.2\times10^{9}$ |
| Recombined muscovite mica paper, aluminum phosphate bonded | $6.7\times10^{13}$ | $2.5\times10^{12}$ | $2.5\times10^{11}$ | $3.4\times10^{10}$ | $2.2\times10^{9}$ | $3.4\times10^{9}$ |
| Steatite † | $3.4\times10^{13}$ | $1.1\times10^{13}$ | $1.0\times10^{11}$ | $8.0\times10^{11}$ | $8.0\times10^{10}$ | $3.3\times10^{10}$ |

* Material in too bad a condition to measure.
† At elevated temperatures, samples were cracked by electrodes even when preheated. (Values are the best estimate obtainable.)

order to be able to migrate in an electric field and that the thermal activity supplies this energy to a few of the carriers not in the conducting state. These assumptions lead to the conclusion that the resistivity should increase exponentially with the reciprocal of the absolute temperature.[1]

The volume resistivities for three materials are plotted against the reciprocal of absolute temperature in Fig. 5. In general, there is a decrease in volume resistivity of one decade for each 100 C rise in temperature above 300 C.

## DISSIPATION FACTOR AND DIELECTRIC CONSTANT

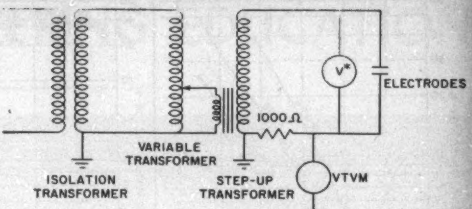
BECAUSE OF THE DIFFICULTY of making the dissipation factor and dielectric constant measurements and the limited amount of time, determinations were made on only two materials. The best sheet insulation and the best spool insulation as determined by previous tests were selected for measurements. These materials were the silicone bonded integrated phlogopite mica and the aluminum phosphate bonded recombined muscovite mica.

Samples 1¾ inches x 2½ inches were prepared from each of the selected materials. Part of the samples was heat aged for 1,000 hours at 600 C. The remainder of the samples was conditioned for 40 hours at 600 C. Gold electrodes were applied to both sides of each sample by vacuum deposition. The test specimens were then placed in a special test fixture (Fig. 6). The dissipation factor and capacitance were measured at 100 cps with a General Radio capacitance bridge, type *716-C,* as the temperature was increased to 600 C. If the measured values exceeded the limit of the bridge at 100 cps, measurements were then made at 1,000 and 10,000 cps. Figs. 7, 8, 9, and 10 give plots of the dissipation factor of silicone bonded integrated phlogopite mica and aluminum phosphate bonded recombined muscovite mica at elevated temperatures. Figs. 11, 12, 13, and 14 give plots of the dielectric constant at elevated temperatures.

The effects of temperature and frequency on the dissipation factor of the materials tested are shown in Figs. 7, 8, 9, and 10. The dissipation factor, in general, increased with temperature and decreased with frequency. The dips in Figs. 7 and 9 probably are caused by moisture in the test samples. At about 150 C the moisture is liberated from the samples and the dissipation factor then increases with increased temperature.

The effect of thermal aging can be seen by comparing Figs. 7 and 8 with Fig. 9 and Fig. 10. The dissipation factor of the silicone bonded integrated phlogopite mica decreased during thermal aging while the dissipation factor of the aluminum phosphate bonded recombined muscovite mica increased.

Figs. 11, 12, 13, and 14 show the effects of temperature and frequency on the dielectric constant of the materials tested. In general, the dielectric constant increased with temperature and decreased with frequency.



* < 5000 VOLTS: RECTIFIER TYPE VOLTMETER
> 5000 VOLTS: ELECTROSTATIC VOLTMETER

Fig. 4. Circuit for electric strength measurements.

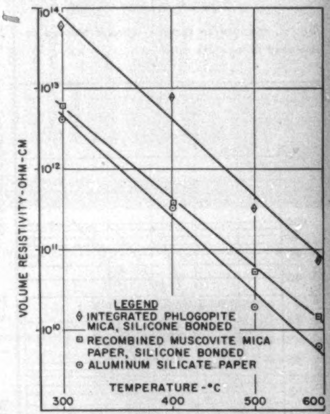


Fig. 5. Volume resistivity.

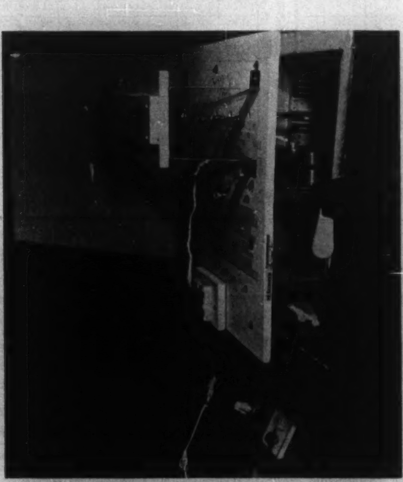


Fig. 3. Electrode assembly for measurement of electric strength and insulation resistance.

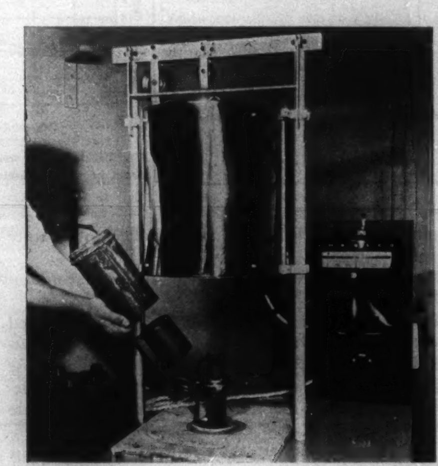


Fig. 6. Test fixture for dissipation factor and capacitance measurements.

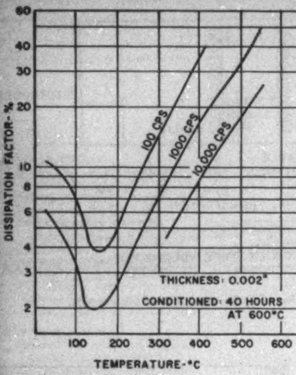


**Fig. 7. Dissipation factor—silicone bonded integrated phlogopite mica.**

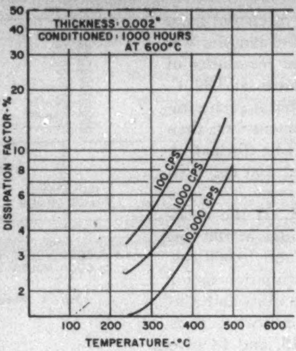


**Fig. 8. Dissipation factor—silicone bonded integrated phlogopite mica.**

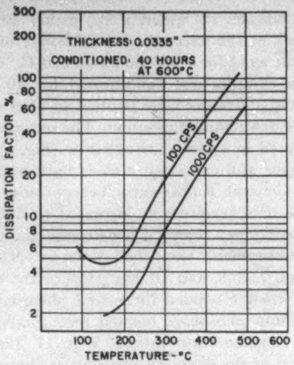


**Fig. 9. Dissipation factor—aluminum phosphate bonded recombined muscovite mica.**

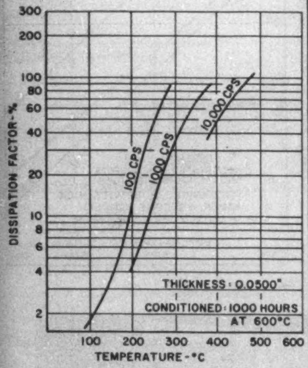


**Fig. 10. Dissipation factor—aluminum phosphate bonded recombined muscovite mica.**

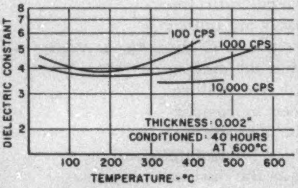


**Fig. 11. Dielectric constant—silicone bonded integrated phlogopite mica.**

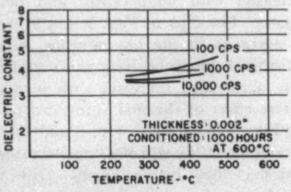


**Fig. 12. Dielectric constant—silicone bonded integrated phlogopite mica.**

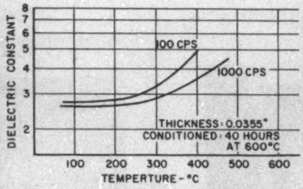


**Fig. 13. Dielectric constant—aluminum phosphate bonded recombined muscovite mica.**

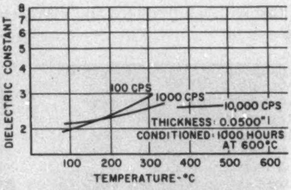


**Fig. 14. Dielectric constant—aluminum phosphate bonded recombined muscovite mica.**

Again the dip in Fig. 11 can be attributed to moisture in the test sample.

Thermal aging tends to lower the dielectric constant of both materials.

The thickness of the aluminum phosphate bonded recombined muscovite mica increased about 40% during heat aging (1,000 hours at 600 C). This increase in thickness could have been caused by a general delaminating within the sample. However, the sample appeared to be in good condition physically. Delamination might also explain the erratic dielectric constant results shown in Fig. 14.

In conclusion there are commercially available materials which are potential sheet and spool insulations for electronic power transformers operating in 500 C ambient temperature. As a result of this investigation, silicone bonded integrated phlogopite mica and aluminum phosphate bonded recombined muscovite mica were recommended for further evaluation as sheet insulation and spool insulation respectively in electronic transformers.

## REFERENCE

1. High Temperature (500° C) Capacitor, R. L. Faust, G. W. Monk, D. W. Moore. Institute of Radio Engineers, New York, N. Y., Proceedings of the National Conference on Aeronautical Electronics, May 1957, pp. 278-85.

# ELECTRICAL ENGINEERING EDUCATION

### AIEE in University of Dayton

**STUDENT MEETINGS in electrical engineering have been an integral part of the curriculum since the beginning of the electrical engineering department at the University of Dayton in 1915. They are still held on a weekly basis. These meetings received national recognition by the Institute of Radio Engineers (IRE) in 1948 and in May 1953 a Joint AIEE–IRE Student Branch was formed. J. N. Yakura is counselor for the Branch.**

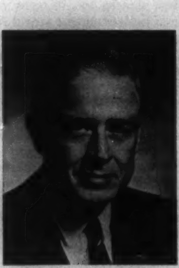
**The Student Branch has been active annually in helping the National Airborne Electronics Conference. Juniors and seniors serve as monitors. The seniors served as well at last year's combined AIEE East Central and Middle Eastern District Meeting in May 1957.**

**The University's Albert Emanual Library is shown at the right.**

ALBERT EMANUEL LIBRARY

## Education and the Science Frontiers

T. J. WATSON, JR.



T. J. Watson, Jr.

THANK YOU for the invitation to come here and talk to you today. It is a privilege and a rare opportunity to talk to such a large group of men who, as engineers, devote their lives to making and improving products which serve mankind.

I have a tremendous respect for engineers, particularly engineers represented by the specialty to which you all belong. Back in 1948, when IBM was one seventh as large as it is today, it occurred to some of us that the pace of development in the data processing field was speeding up. We realized that the whole concept of our research spending would have to be changed if we were to fulfill the opportunities being presented to us.

After a great deal of discussion and planning, we plunged into research spending at a rate unprecedented in our history, and this spending continues to this day.

The result—our company has increased 700% in 9 years and the most significant factor in that increase has been our research program.

My associates and I have a fair reputation as a management—and this has been earned for us largely by our engineers; so I believe solidly in engineers.

I am sure you have all heard of Nicholas Murray Butler, the great president of Columbia University. He once said that the world is made up of three groups of people:

> The first group, a very small one—who make things happen; a somewhat larger group—who watch things happen; and the great multitude—who don't know what happens.

That the engineer makes things happen, and is part of the select company of the first group, is evident in our everyday lives. In the past 20 years, you have been modifying our civilization at an ever-accelerating pace. Today, we live in a marvelous era where the pushing of buttons by the housewife, the mechanic, the factory worker, the airline pilot—yes, even the businessman—accomplishes a very significant part of the work of the world.

Knowing that you are one of the influential groups who make things happen, I want to lay a major problem and possible solution before you today.

I heard a prominent Republican speak the other night of the situation in Washington. He said, "The Republicans think we're in a heck of a mess and it's rapidly going to get better, the Democrats think we're in a heck of a mess and it's going to get worse, and the Independents think we're in a heck of a mess and it's going to stay about the same."

Everyone agrees that we are in a mess. How did we get there?

We have had a few problems since the end of World War II, but mainly we have been concerned with improving our standard of living. For some reason, many of us believed that if we could continue to improve in this area, everything else would fall in line. We have become so enthusiastic about making our easy life even easier, that we seem mesmerized with the development of our own creature comforts.

#### Sobering Events

But, in the midst of these pleasant prospects of progress, prosperity, and plenty have come several sobering events.

In October 1957, the Soviet Union

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Essentially full text of an address made at the General Session of the AIEE Winter General Meeting held at the Hotel Statler, New York, N. Y., Feb. 2-7, 1958.

T. J. Watson, Jr., is president, International Business Machines Corporation.

# Electrical Engineering Education

launched Sputnik I and, in November, Sputnik II. This was followed in December by the dramatic failure of the United States to put up its first satellite. We are all now encouraged by the performance of our own satellite.

As an Air Force pilot, I lived in the Soviet Union during the latter half of 1942. Seeing her then—her air force, army, and some of her factories—made me believe she could never be a threat. Everything I saw was second or even third class. A great many American citizens through reading their newspapers, etc., reached the same conclusion that I had. Until October of last year, many of us lived in that comforting opinion. We have now been awakened with an unpleasant start. All our comforting beliefs about the rate of scientific progress in a dictatorship must now be revised.

Many of us both here and abroad have misread the Soviets: their ability, and their determination. We have always felt that anything they could do, we could do better; and suddenly our eyes and the eyes of the world see that we can't.

Our scientific progress, which seemed, only a few months ago, to be so outstanding and to be leading the world in nearly every area, now begins to give us some doubts. For the first time in 50 years, another nation has been able to make a scientific and psychological breakthrough of major proportions that we, in the United States of America could not immediately duplicate. Throughout America our citizens are beginning to wake up with a fearful start. We, who are always first, are now surprisingly second in at least one area.

Obviously, we maintain our leadership in many things, but I doubt whether this is enough for America, particularly when we want to preserve our democratic principles and prove to the uncommitted nations that our way of life is the best for all concerned.

There is comfort in the fact that this United States awakening is caused by an earth satellite rather than a bomb on one of our cities. I'm glad to be living in the United States in 1958, because I believe it is the period of America's greatest challenge. We are going to see the United States really move in the years ahead. Move we must—or we lose.

### Education Is Key Area

I believe that all the fundamental frontiers of today's world begin in the educational area. This is where one finds the real battleground for the winning or the losing of the long-term contest with the Soviet Union.

Our progress is as good as our minds, and how we use our minds. Our youth, to lead the world, must have wonderful minds and then have the incentive to use their minds as well.

The postwar demands for consumer goods drew multitudes of qualified teachers away from educational institutions and into industry. The movement was speeded by a continual lessening of the economic position of the teacher. We upgraded industry and industrial production and downgraded teachers.

Contrast our pattern for a moment to the experience of other great nations. We all recall the great teachers of Greece and Rome. In almost all great nations, the population by one method or another has made it possible to expose the cream of their youth to the cream of their best thinkers.

I am persuaded that in the first 125 years of our history as a nation we did the same thing. It was easy to do, inasmuch as the teaching profession was one of the natural places for great minds to go because there was no industrial competition. As more lucrative nonteaching jobs presented themselves, the ratio of outstanding teachers to students was reduced. Now, too frequently it is the exception when a gifted and outstanding person turns to teaching as a life work.

Let us look very briefly at what the Soviet Union was doing during this time when we were making such dramatic improvements in our standards of living, while our great potential teachers were becoming scientists and industrial executives.

With great determination, the Soviets decided to lift themselves from a second-class nation status—in power, research, and prestige.

Her people have had a very slim increase in living standards in the past 10 years. With the money, effort, and manpower that might have been spent in other areas, the Soviet Union has built up its educational and research facilities to a point where they rival ours. She has continued to upgrade her air force and army, and I need not say what she has done in rocketry.

### Teaching Profession Neglected

We live in a dollar economy in America. All of us with rare exceptions are working to make more dollars. There are other motivations, but this is one of the more powerful ones. Our whole country and the free enterprise system itself is based upon each one of us striving for a better life for our families.

However, this premise has been forgotten in the teaching profession. Although most of us in the United States have gained ground economically since World War II, teachers as a group actually have lost. Little wonder then that many of our best potential teachers have gone into industry. A man must be dedicated indeed to undertake one of the world's toughest jobs at less salary than he could get in industry.

At present, the good teachers in the system are those unusually dedicated men and women. It follows then that the teaching profession must also have a substantial group of people less competent than they should be.

There is another tragic aspect to this situation. Think back, if you will, to your growing years and remember who had the greatest influence upon you outside of your parents. One of your teachers I'm sure.

And so, we have made this profession which had and has such major influence on our children into a second-class profession with poor pay and little prestige.

While the United States teaching profession was slipping, the Soviet system was being upgraded. Now we hear that secondary school and college teachers in the Soviet Union are compensated on a level with business executives in this country. When you stop and think of it, this is logical and right. If you want top youth, get top people to educate them—it's as simple as that. The only fly in the ointment is that we are not doing it. And I submit that the quickest and most effective cure is a dollar cure and that the price while initially staggering is little enough to pay for a continuance of our democratic system.

The fundamental job, in my opinion, is to recruit outstanding people for the teaching profession and upgrade the people presently in the program, with equal emphasis on the elimination of the incompetents.

How do we do it? In a word, more dollars.

We cannot do it by edict; we can do it only by attraction. The one way to attract good people is to provide them with challenging jobs and with incomes sufficient to provide the status which competent men desire for themselves and their families.

Here in the United States, we pay our college professors on the average approximately one and a half times as much as our industrial hourly workers.

In the Soviet Union, a professor is an economic giant, earning eight times as much as the average Soviet citizen in a manufacturing plant. It is a tragic commentary that the Soviets should use capitalistic concepts to motivate their educators while here in the United States, we have almost socialized the teaching profession. The average salary for a teacher in our secondary schools is a little over $4,800 per year and that of a college or university professor is $5,600 a year. On the other hand, in the USSR, the spread from the top to the bottom in the teaching profession is of the order of 15 to 1, with top salaries as high as 15,000 rubles per month. At the official exchange rate, this would be about $38,000 per year, at the unofficial rate $30,000—still a handsome salary.

If we were just to bring the purchasing power of our teachers back to prewar levels, it would be necessary to increase their salaries by at least 75%. And, clearly, this is not enough if we are to attract the best manpower into the teaching ranks.

### Financial Incentive Needed

To provide adequate financial incentive, I believe we must gradually adjust starting salaries upward to about $5,000 per year in high schools and $6,000 to $6,500 in our colleges and universities. Simultaneously with the adjustment in starting incomes, the average income should be moved up to about $9,000 for high schools and $12,000 for colleges and universities. These averages would provide adequate spread from top to bottom and sufficient incentive to attract and retain our most promising manpower in the field of education.

Before the job is successfully done, it may be that teachers' incomes will have doubled. This is shocking, and expensive, but I submit that this can be the best and cheapest investment the United States has ever made.

How much will it cost? In 1957, the total amount paid in the United States to high school teachers was $2.2 billion and to college professors $1.3 billion for a total of $3.5 billion. If this were doubled, the total bill would go to $7 billion and with a 40% increase in numbers of teachers required by 1965 to $10 billion. The increase of $6.5 billion at the end of 8 years, some of which would come anyway due to increasing population, compares with the several billion dollars of increase in military spending already planned as a result of the Sputniks. Analyzed against the estimated $90 billion budget for 1965, it isn't nearly as staggering as it seems at first.

I do not propose that everybody's salary be doubled. There is undoubtedly a percentage of these teachers who are not worth one iota more than they are making. The distribution of the funds becomes a local problem. But, until such time as there are drastic changes in the salary structure for our secondary school teachers, we will not have the quality of teaching that we need.

High school organization and promotional policy now is almost on a civil service basis. Salary depends on type of degree held and upon seniority. Generally there is no provision to upgrade the outstanding and influential teacher at a faster rate than his less competent associate.

This must be changed if large numbers of people with competence and ambition are to enter and grow in the system. To accomplish this, local principals should be given very broad authority to upgrade the pay and title of teachers in their high schools with little or no attention to seniority. This is the system that pertains in industry and science and it has produced many outstanding scientists and executives. It can do the same in the teaching profession.

Let's look at it another way. Suppose we leave the teaching profession the way it is. Suppose Soviet research begins to outpace us on many fronts instead of a few. Think for a minute not only of the threat they become militarily, but also in the battle for men's minds they would begin to win with alarming rapidity.

We must face the fact that we have led the world with ease for a number of years but we have led because we were strong and able. Look at the post-Sputnik attitude of the NATO nations and you can see on a small scale what will surely happen on a large scale if we are out-Sputniked again.

We cannot afford to lose the respect of the world and, for my money, the best way to regain it and retain it is through a fundamental change in our whole approach to the educational problem.

I am interested in making the greatest possible change in the shortest possible time. The present situation is dangerous, and I believe that the application of the incentive system to the teaching profession is the strongest step we can take. We seem to have forgotten this basic United States concept when it comes to teachers.

Tragic that we, who have applied the incentive system to produce the highest standard of living that the world has ever seen, should neglect to apply this system to something as sensitive and important as our educational system.

### Federal Subsidy Urged

Now I haven't mentioned how these increases in salaries are to be paid for and I've thought at length about a practical solution. In colleges and universities, some say increase tuition and others say increase corporate donations. Still others have other suggestions and each one has individual merit.

However, if this is a job that must be done at once and I am presuaded that it must be, then I believe that outright Federal subsidy of a part of the salary of all teachers in accredited secondary schools, colleges, and universities is the only answer.

I don't like Federal subsidies any more than anyone else, but I recognize that we are dealing with a problem where a "business as usual" solution is inadequate. We need a new and positive approach and I believe Federal subsidy is it.

Let's not see too many ghosts in a Federal subsidy for education. Nearly every university in Europe has been supported by government to a greater or lesser degree for years and their product is excellent.

If we want to say no to Federal subsidy, let's think of an alternative which can be applied effectively and at once—an alternative which will bring about an immediate upgrading of the whole system. I could think of none.

### Need for Drastic Action

Well, gentlemen, that is the thought I want to leave with you today and in order to decide whether or not you agree with me, it is necessary for you first to decide whether or not the United States is in a really serious situation and this, in itself, is an exceedingly hard task.

Some of our distinguished scientists say that the placing of a satellite in orbit around the world is a scientific breakthrough of the first magnitude comparable and only slightly less important than the

creation of the atomic bomb by the United States during World War II.

If one listens to the discussions in Government circles, the situation becomes very confused. Some pour oil on the waters and tell us not to panic, that things are not nearly as bad as they seem, that in certain areas the Soviet Union may be a little bit ahead of us but that in other more important areas we are substantially ahead of them. Others talk as though the battle was already lost.

I have thought a great deal about the situation and have concluded that our country is in greater danger than it has ever been in her history. I don't believe we can win the sort of contest that we are in with the Soviet Union on a "business as usual" basis. I don't believe that all of the things that need to be done can be done without increasing the taxes that all of us pay. Our living standard is going to have to stop going up temporarily—even be reduced, perhaps drastically. We've got to make America hard and lean again.

Unless we face up to these requirements of the situation, we can whistle ourselves into a sort of complacency that could be Chapter I of the Decline and Fall of American Democracy.

Everyone of you shares my interest in our country, and we all know we have got to be right or be willing to live under a yoke of slavery. Therefore, in thanking you for your attention, I ask that you consider my words. If the situation seems to you to be as drastic as it seems to me, let us join together in keeping this matter in front of our people and our Government until the sort of drastic steps are taken that will guarantee our emergence into the successful era of the future. Then we will have far out-paced the Sovie Union and will have won so many of the uncommitted minds of the world that we can go back to the wonderful business of improving our creature comforts, our standard of living, and the prosperity which has made us great.

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# India's Engineering Education

**R. W. ATKINSON**
FELLOW AIEE

WHEN, after only a brief stay in India, I write about Indian engineering education, it must be recognized that I do this only to address fellow engineers who have not had even that experience. Perhaps the brevity of my Indian experience wil even help me to write in terms of th interest of the audience whom I address—I can so well remember what would hav been new to me only two years ago. Thi introduction is, more than anything els a disclaimer of my being, even remotely an authority on the subject of which write.

English is the national technical lan guage of India and all instruction at th

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A special article recommended by the AIEE Educational Publications Committee

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# Electrical Engineering Education

college level is given in this language. Although the use of some Western language is a practical necessity, it does mean a large burden and a large linguistic accomplishment not required of those of us who can acquire our technical education in our native language. Most people in the United States, even after several years of studying German or French in high school or college, would not be very happy to be required to carry on their remaining education in that language. The language accomplishment is further emphasized by the fact that English differs from the various Indian languages far more than French or German differs from English.

India's climate—not simply the fact that it is tropical—affects, in a way that few Americans would expect, all of her activities including education. India's hottest months—what they call summer—are April and May (and late March and the early part of June). In spite of the dryness at this time, the hotter part of the day is not conducive to hard work, either physical or mental. It is during these months, corresponding to our July–August period, that the educational program is relaxed or discontinued. Colleges open about July 1st with weather still pretty warm but quite within the experience of most Americans.

### The Problem of Expansion

India's big problem of engineering education is in the terrific rate of expansion of engineering training which is required for the rapid industrialization that is taking place and is planned. The United States is thought to have an expansion problem in its colleges where the student population of engineering (degree) students has increased from 225,000 for the academic year 1946-47 to 243,200 in the academic year 1955-56, or 8.1%. Total enrollment in the academic year 1960-61 is expected to be 338,000 for an increase of 39% over the 1955-56 figure. In India, the admissions to degree institutions have increased from 2,900 in 1947 to 6,300 in 1956 for an increase of 117%. The second five-year plan now under way contemplates increasing that number to 10,000 per year or a 58.8% increase. In the same over-all period, it is expected that the annual number of admissions to the "diploma" (or technical institute) courses will have increased from 3,700 to 20,000. If any course other than civil engineering is picked, the relative rate of growth is still more remarkable.

Staff and facilities cannot be increased at a proportionate rate. One effect of this situation is that educational methods that were drawn up many decades ago to fit very different conditions and that already were becoming outmoded are fast becoming obsolete and impossible. More advanced school administrators have recognized the necessity of a "new look" and, with a will, are proceeding to meet new conditions. Recasting an educational system would not be an easy thing with a stationary student population. Accomplishing this with the enormous rate of expansion of school population that is taking place is a tremendous task. Naturally, many individuals of any staff as well as some whole staffs have not yet recognized the problem and even when the problem is recognized, the development of means to handle it under the local conditions will take all of the ingenuity and arduous work that can be given. It will produce many gray hairs and may send to an early grave some of the more progressive and earnest leaders.

### Older Educational System

It may be of interest to list a few of the characteristics of the older system of education in India that do not appear well adapted to modern requirements.

(1) There are what we would consider an excessive number of contact hours between student and staff (around 40 hours per week). This may have worked (and probably did) when the students were few—permitting small classes—and when, because of the very small enrollments, it was possible to be highly selective in admissions. The large classes which now are necessary because of the staff shortage are made still larger by the excess contact hours with the result that individual contact is lost even more completely than it need be.

(2) In general, the "passing," grading, and graduating of students is largely determined by year-end examinations which are conducted by an agency which is not the local school. Usually this agency is a "university" the most obvious function of which, to a stranger, is that of an examining body rather than what we think of as a University. (Of course, the detailed work of correcting and marking of papers, etc., is farmed out among various persons including the related faculties.) This system of external annual examination tends to affect, in various undesirable ways, the whole educational program.

(3) To an Indian student, the cost of the best text books is excessive and many simply do not have books. This lack has fostered the attempt to put over the information entirely in lectures and that in turn, has caused the non obtaining of books by students. This situation will improve rapidly through the co-operation of Asian and American publishers; the more popular American text books will be printed in Asia to sell at a cost within the means of Indian students. As the number of such books increases, the value to education in India will be tremendous.

A sidelight on the comparison between the Indian and the American economy is the often-made statement that a rupee (at the official and usual exchange rate, about 21¢) will buy as much in India as a dollar bill will in the United States. This can be put into more meaningful terms. Almost no one in India has an income larger in number of rupees than would be the income in number of dollars of an American doing the same work and having the same responsibility. In many cases, the difference is far more marked; for example, five rupees per day will employ a competent mechanic or tradesman, and there are very many whose income is much, much smaller than that. This has a counterbalance. When a man buys services or something that results largely from service, he can buy as much with each of his rupees as his United States counterpart can buy with his dollars. However, there are many desirable things that are not yet produced in India, or are produced at a comparatively excessive cost. For these, the Indian must pay not merely the foreign cost but the freight and duty charges too. By way of example, he will pay 10 times as many rupees as an American pays dollars for his car and, in the same ratio, for gasoline to fill the tank. His cost per unit for electric power is about what ours is. For many, telephone service is almost nonexistent. Long distance telephone service seems quite hopeless. Mail service is surprisingly good (at a cost approximately the same as in the United States). In my experience, a telegram arrives after the confirming letter, although I know that cannot be typical. Some of these things are very pertinent to the need for development of India's industries and the corresponding need for more engineers.

### America's Place

Now where does America fit in all of this—and why, and how? First, the *where*. India's industrial expansion program—of which expanded engineering education is a vital part—has been called "Operation Bootstrap." Anyone who sees what is being done and has been done on these plans (and, thus, is given confidence in the future plans) marvels at the vision and determination and stamina—and the results. In terms of the effort put forth by India, the American contribution has been and is small. However, the result is extremely important; one may compare the case of someone coming upon a group trying to push a stalled car out of a ditch. With the help of the new man, and perhaps of the encouragement given, the car is pulled out. Actually, this simile is not very good because the help America can give is of a different kind than what is supplied locally. In building a dam, it may be the huge earth-moving machinery instead of women carrying baskets of earth on their heads. In education, it may be helping to adapt some American methods to local conditions. It may only help give a man courage for his convictions when he needs backing in making a major change from a previous practice, or give him support against someone not yet convinced. Americans are experienced in knowing how to try out a new plan in a way that increases the chance of success and guards against failure being too costly and yet profits from the failure by showing the way to a better plan. It is to be recognized that where so great an increase of enrollment occurs, a staff must be young in average age and experience. To such, the outside advice and assistance on new problems can add much to their confidence and efficiency. The "guest professor" may show the way or he may show how best to learn from trial and error. Few persons can have had such an

## Electrical Engineering Education

opportunity for satisfaction in accomplishment or a chance to work with people generally more ready to accept help and to appreciate what is being done.

Now the *why* of America's part in this. Many will say that, where the need for help is so great and the opportunity to be useful is so great, America should go in and do her part. Many others will say that America has problems enough of her own. But to all, there is the matter of the self-interest of the United States. India's Finance Minister Krishnamachari has been roundly attacked by the Communists for the statement he is said to have made in the United States that Kerala (one of India's small states) would not have gone Communist if India had been able to advance her economy somewhat more rapidly. There were, apparently, contributing causes in Kerala but I think that keeping India a part of the free world and not captured by Communism, in no small degree, is dependent upon a reasonably rapid increase in the wellbeing of her people. I think that the money the United States spends in reasonable and efficient help to nations like India constitutes the best kind of defense dollars she can spend.

Now the *how*. This is part of the "Point Four" program which is administered in Washington, D. C., by the International Co-operation Administration (ICA). The operation in India is coordinated by what is called the Technical Co-operation Mission of the U. S. (TCM). The very practical and efficient method of helping the individual institutions in India under this program is that, under a contract from the U. S. Government through ICA, various universities in the United States act in a "Sisterhood" relation to one or more Indian counterparts. American guest professors are sent to work at the Indian institutions and Indian professors and students are sent to America for study, research work, and filling teaching positions. A major portion of the expense of these operations is borne by the United States, through the university contract but the Government of India provides the cost of certain very important items as arranged in the contract between the Governments. The professors sent by the American university are actually staff members of the university faculty although, not infrequently, temporarily employed under contract for the particular mission. The operation of the project for the American university is under the active guidance of a high officer—for example, in one case, a recently retired dean of engineering. Also, top administrative officers of the institution have close personal knowledge of the project.

There are many other international agencies contributing toward international wellbeing such as UNESCO, Ford Foundation, Rockefeller Foundation, Colombo Plan of the Commonwealth Nations, etc. These various agencies co-operate and supplement each other but there is no space here to do more than name some of these.

Recruitment of American personnel to implement these international programs (not alone in India) has been hampered by the shortage of faculty in our own institutions and by a very greatly exaggerated conception of the hardships of life in these countries. Actually, the difficulties are easily overcome and are, indeed, far less than were encountered in the first year of the program. For the individual American—and his family—there is an opportunity for some of the greatest satisfaction in life in seeing tangible results of his work in a direction so important, at the same time, from the standpoint of humanity and of the safety of America and the world.

### AIEE Members Participate

Members of the AIEE other than the writer, whom I know to be participating or to have participated in this work in India include the following: F. H. Pumphrey, R. R. Benedict, J. G. Holm, M. G. Malti, and M. G. Young. Incidentally, there are twice as many mechanical engineers as electrical engineers presently taking part in this program in India.

### Development of Symposiums

America's engineering conventions and symposiums provide an excellent means of disseminating new knowledge as it is gained and, thus, in promoting engineering developments rapidly. India has not yet developed this method to a comparable extent. As one step in this development, the college served first by Prof. Pumphrey and now by the writer sponsored and operated a symposium on Electric Power Transmission and Distribution in May 1957 (*Electrical Engineering*, October 1957, p. 903). Although some useful papers were original, we found that one of the effective ways to produce useful papers is to use available current literature. Because of its availability and extent, publications of the AIEE furnished the major basis for some of the papers. By having preprints sent by air mail from the United States, some of the subjects could be discussed in India at a date almost as early as they were discussed in the United States. In some cases, a group of papers and discussions of a single subject were presented together. The proceedings of this symposium were printed in the *Indian Construction News* for the following month. For some time to come, such symposiums may be the best method of disseminating the growing knowledge of engineering and of permitting group discussions in India of many of the current topics. This College conducted a similar meeting in February 1958 and other colleges are considering similar projects.

It is an interesting thing that so many Indian engineers have joined the AIEE when it is considered that, relative to his income, this membership costs an Indian engineer at least five times as much as an American engineer. In America, we do not realize sometimes how low the cost is to us or some of the very good things that come to us through membership. But, for a long time to come, most of India's younger engineers will be able to obtain the educational benefits of the AIEE only through such indirect means as I have just indicated.

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# An Electrical Engineer in Industry

**H. J. HUMMEL (AM '52), engineering group leader, Motorola, Inc., Chicago, Ill.**

"Membership in the AIEE is a very important facet of my professional life. Being an electrical engineer engaged in the electronics field generally, and in the communications area specifically, and even more specifically the mobile communications field, it would be very easy to be interested solely in organizations that are directed at the immediate area of interest. However, the AIEE, because of its broad interests serves as the link that ties together a multitude of highly specialized branches of electrical engineering. It provides the practicing engineer with a means for keeping abreast of major progress in the entire field of electrical engineering. As the art of applying and controlling electrical energy advances, the need for interchange of information between fields becomes ever more important."

Mr. Hummel received a B.S. degree in E.E. from Illinois Institute of Technology where he was elected to Phi Eta Sigma, Eta Kappa Nu, and Tau Beta Pi.

His professional experience has included five years with Motorola, Inc., as a mobile communications receiver design engineer. During this time, he progressed from the status of a junior engineer to project engineer, and then senior project engineer, and has recently been appointed an engineering group leader. Mr. Hummel is a registered professional engineer in the State of Illinois.

# Electrical Engineering Education

## Nuclear Reactor Project at the University of Akron

The University of Akron is losing no time in putting its *AGN-201* nuclear reactor to use for educational purposes. Recently, the University has: (1) received a $19,727 grant from the Atomic Energy Commission (AEC) to equip and supply a radiation laboratory for the operation of the reactor, (2) conducted the first orientation class in atomic power and the role of the reactor for representatives of an Akron industry, and (3) announced that it would offer during the Spring semester the first regularly scheduled course in atomic power.

Concerning the grant from the AEC, Dr. N. P. Auburn, University president, said, "I am gratified that the University is to receive this support from the Atomic Energy Commission in the extended operation of our reactor. This reactor, a splendid gift from the General Tire & Rubber Co. (whole subsidiary, the Aerojet-General Nucleonics Corp., makes the *AGN-201*) last Fall, is of tremendous value in the training of our students in physics, engineering, chemistry, and biology."

At about the time the grant was announced by the AEC, 13 representatives of the Goodyear Aircraft Corporation (GAC) were attending the first orientation session offered by the University to familiarize industry personnel with atomic power and the reactor.

The GAC class included O. W. Loudenslager, research and development coordinator; J. O. Gibson, design engineering manager; Louis Manning, project engineer; F. A. Pake, thermodynamics manager; Leo Jurich, development engineer; Dr. R. S. Ross, aircraft research and development manager; G. W. Quaint, test operations manager; C. A. Meneley, systems research and development manager; A. W. Cook, wheel and brake development manager; A. B. Cribbs, tooling division manager; Albert Goulding, plant engineering division manager; and A. F. Novick, training manager.

Teaching the two-hour session were Prof. W. M. Petry, head of the mechanical engineering department, and Prof. E. R. Thackeray, head of the physics department.

Following the orientation period, it was announced by Dr. D. J. Guzzetta, dean of the Evening and Adult Education Division, that eight area industries have expressed interest in having some of their qualified personnel take similar orientation training.

Along this line, the University announced that a course called "The *AGN-201* Nuclear Reactor" was to be offered during the Spring semester. This is the first regularly scheduled class to use the reactor as the sole basis of its studies on the Hilltop.

At present, some courses utilize the reactor for certain periods to illustrate certain aspects of a particular subject. The mechanical engineering class in "Power," for example, devotes part of its time to studying atomic power and power applications of reactor systems.

The University, in its application for the AEC grant, said other courses will soon make use of the reactor. They include physics, chemistry, and engineering subjects.

Fully licensed by the AEC, the University recently received permission to "receive, acquire, own, possess, transfer, and import byproduct radioactive material." These include cobalt-60, polonium-210, and strontium-90.

Prof. Petry is licensed by the AEC as a qualified reactor operator. Ten other faculty members have studied the reactor operation and are waiting to take a special AEC examination that will qualify them as operators.

There is absolutely no danger from atomic radiation from the *AGN-201*, which has been declared safe for operation in compliance with the license issued by AEC.

## Doctoral Program in Engineering Mechanics Offered

A graduate program in engineering mechanics, leading to the degree of Ph. D. has been announced by Dean Joseph Weil of the College of Engineering, University of Florida at Gainesville.

The doctoral program in engineering mechanics is a response to the increasing emphasis on engineering science in professional training as opposed to education for a special field, according to W. L. Sawyer, head professor of engineering mechanics.

The department of engineering mechanics of the Florida College of Engineering, has been offering the masters' degree with a major in engineering mechanics for the last 10 years.

## Annual ACE Day Scheduled by OSU College of Engineering

The 5th Annual Conference for Engineers and Architects—known as ACE Day—sponsored by the Ohio State University (OSU) College of Engineering, is scheduled for May 2, 1958, on the Columbus, Ohio, campus.

Principal speakers, announced by Engineering Dean G. B. Carson, who is Conference director, will be Maj. Gen. J. B. Medaris, commanding general of the U. S. Army Ordnance Corps' Ballistic Missile Agency, Huntsville, Ala.; and J. C. Zeder, vice-president, engineering, and special adviser to the president of Chrysler Corporation, Detroit, Mich.

Gen. Medaris will keynote the opening general session at 10 a.m. in the Mershon Auditorium. Mr. Zeder will be the speaker at a luncheon session in the ballroom of the Ohio Union. The Conference will open officially at 9 a.m. with registration in Mershon Auditorium.

Following the luncheon, technical sessions are scheduled at 2 p.m. in the various departments of the College of Engineering. An innovation this year will be four general technical sessions, each sponsored jointly by a number of departments.

The joint sessions will run concurrently, and all will be in the Ohio Union. The departments of aeronautical and electrical engineering, engineering mechanics, and physiology will sponsor a session on "Satellites and Space Craft" which will feature discussions on "Flight Mechanics of Orbital Bodies," "Performance and Size of Rocket Launchers for Various Types of Orbits," "Radio Telescopes and the Tracking of Earth Satellites," and "Physiological Aspects of Space Flight."

The departments of chemical, mechanical, and welding engineering and physics will present discussions in the field of "Nuclear Engineering." Included in the program will be "Current Trends in Nuclear Power Reactors," "Nuclear Fuel Processing and Waste Disposal Problems," "Metallurgy and Cost of Nuclear Fuel," and "Nondestructive Testing of Nuclear Components."

A session on "Computers" will be sponsored by the departments of civil and electrical engineering, engineering mechanics, and mathematics, and will include discussions on "Digital Computers—Principles and Applications," "Analog Computers—Principles and Applications," "Digital Computer Application to Highway Bridge Design," and "Analog Computer Simulation of Human Pilot Behavior."

The "Automatic Controls" session, sponsored by the departments of aeronautical, electrical, industrial, and mechanical engineering, will include discussions on "Feedback and Control Systems," "Application of Design and Analysis Techniques for Feedback Control Systems," "Aeronautical Applications of Automatic Control," and "Effects of Random Variations in Control Systems."

Topics of the individual departments in technical sessions will include: *agricultural engineering*—recent research in soil tillage and corn harvesting machines and a panel on research needs; *ceramic engineering*—fine structure of ceramic materials; *chemical engineering*—operating experiences with a large hot lime zeolite system for 1,500 psi boilers, and presentation of student awards; *engineering drawing*—engineering and drafting services for today's industry; *industrial engineering*—concurrent seminars on linear programming, case study in industrial operations research, and ceramic turning tools; *mechanical engineering*—mechanical engineering aspects of hypersonic flight; *metallurgical engineering*—current trends in metallurgical development; *mining engineering*—mining production control; *petroleum engineering*—radioactivity well logging in Ohio; *photography*—photography as a tool in the solution of engineering problems; *school of architecture and landscape architecture*—OSU campus plan, case studies of construction, inspection trips, and seventh OSU Development Fund sponsored lecture; *welding engineering*—new concepts in fusion welding.

The ACE evening program will consist of departmental tours and inspections and social get-togethers of alumni and friends. Program and pre-registration information can be obtained from Associate Dean H. A. Bolz, chairman of the Conference committee.

## Summer Career Program Aids in Scientist Recruitment

A program which gives students an opportunity to become acquainted with a Government research laboratory during their summer vacation periods is helping the National Bureau of Standards (NBS) to meet its increasing demand for high-caliber technical graduates. Having discovered for themselves the advantages of a professional career at NBS, 174 of 1957's record enrollment are maintaining NBS affiliation: of the 236 students employed at the Washington (D.C.) laboratories in the past summer, 44 are still on full- or part-time duty, and 130 who plan to return to NBS have been granted leave without pay to continue their education. One half of the 208 students employed in 1956 were included in last summer's program. Another 57 had remained on duty permanently. The program, inaugurated in 1948, was extended to the NBS laboratories in Boulder, Colo., in 1956, where it has already resulted in a number of permanent appointments.

Thus, the Student Trainee Program, which enables college men and women to apply their education in jobs selected according to their interests, is proving mutually beneficial to employer and employee. Actual participation in laboratory work has been found to be not only an incentive for continuing scientific studies but also a help to the student in formulating career objectives and in integrating classroom work with actual laboratory experience.

In addition to being successful as a long-range recruitment plan, the Student Trainee Program demonstrates the ability of younger employees to make direct contributions to the recearch program. For example, written evaluations by supervisors at the Washington laboratories showed that almost 85% of the 1956 trainees did above-average work.

Outstanding work was performed by several students. Summer student R. C. Burton, now a permanent employee, made a valuable contribution in developing a mathematical theory for design of experiments, for which he received a superior performance award of $300. He was co-author of a technical paper on the subject. Some other 1956 students with papers to their credit are J. A. Miller, physicist from the University of Maryland, C. T. Zahn, physicist from Princeton University, and H. D. Dixon, chemist from North Carolina State College.

The valuable work which students turn out has received recognition outside the NBS also. P. M. Fulcomer, Jr., a 1957 graduate of Northwestern University received the Junior Engineer Award for 1957 of the Washington Society of Engineers. The acknowledgment was made for work he did as a student at the NBS on standardizing electronic circuits. Mr. Fulcomer, who was enrolled in the trainee program as a co-operative student for five years, is now a permanent employee of the NBS engineering electronics laboratory.

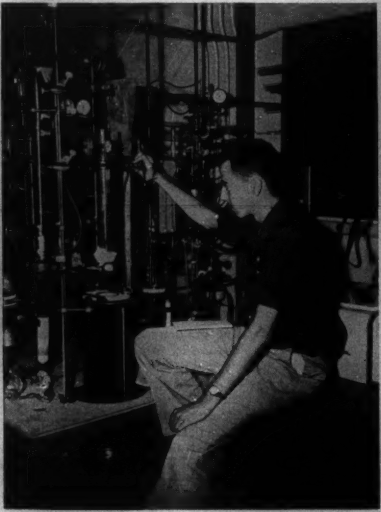
During the summer of 1957, students aided in projects ranging from radio propagation studies to developing test methods for acoustic tiles. Programming problems for automatic computers, standardizing isotopes used in medicine, measuring the velocity of free-radical recombination, and designing cryogenic equipment were just a few of the activities engaged in by the young scientists. Of the 1957 trainees, 95% received a "good" or "excellent" performance rating after careful review of their work.

## New Program at Columbia To Encourage Two-Year Ph.D.

Higher education's equivalent to the 4-minute mile—the 2-year Ph.D.—will be accomplished more frequently as the result of a program for specially qualified chemistry majors to begin in September 1958 at Columbia College.

Frank Bowles, president of the College Entrance Examination Board, calls the plan "one of the most daring and imaginative proposals I've heard in a long time," declaring that "the thing I like about it is that it doesn't pose any threat to standards. It rather accentuates them and fortifies the entire concept of quality education." The Board's advanced placement program figures in the Columbia College plan.

Announced February 2 by Dean L. H. Chamberlain, the program, which will help to alleviate the nation's shortage of research scientists, seeks primarily to fill a need for superb scientists who are also



**NBS SUMMER STUDENTS (above) learn about purification by crystal growth from Dr. John Torgesen of the NBS staff. This demonstration was part of a tour designed to familiarize the students with the scope of NBS work. *Right:* One of the summer students, R. H. Armsby, a 1956 National Science Fair finalist, adjusts apparatus in the NBS free radicals research laboratory designed to measure the velocity of free-radical recombination. Mr. Armsby is a sophomore in engineering physics at Cornell University.**

broadly educated men. It is the product of many months of discussion between Dean Chamberlain and Prof. R. S. Halford, executive officer of the department of chemistry, where the program originated.

Like the 4-minute mile, the Ph.D. in 4 years of college and 2 years of post graduate work has been achieved heretofore—but with perhaps equal infrequency and with sacrifice of the traditional elements of a liberal education. Dr. Halford said that most chemistry students require almost 4 years of graduate work for the Ph.D., some have needed as many as 7 years, and with only rare exceptions the minimum in recent times at Columbia's graduate Faculty of Pure Science has been 3 years.

Now, through annual enrollment of some 25 top-notch high school graduates who have proved, by their total performance and by their scores on College Entrance Examination Board tests, that they qualify for advanced placement in chemistry; and through an undergraduate program for these students so strong in chemistry that they will be able to begin research for the doctorate in the senior year and eliminate lecture courses in graduate school, the door will be opened to regular performance by excellent students of a feat previously accomplished but rarely.

Best of all, Dr. Halford declared, the chemistry-laden program, far from selling short the humanities and social studies, actually heightens the emphasis on these areas—together with science the basic elements of Columbia College's famed General Education program. In addition to language courses and the traditional, rigorous 28 points of contemporary civilization and humanities, all of which are required, advanced electives in the nonscientific disciplines will be prescribed.

The program, which will produce graduates ready to begin full-scale chemical research in graduate school, calls for 144 points of credit as compared to the 126 points required of all students for graduation. According to Dr. Halford, many chemistry majors in Columbia College regularly take this exceptional number of points but, because they do not enter with advanced standing in chemistry, they never complete in college sufficient classroom work in chemistry to enable them to begin full-time research immediately on entering graduate school.

In commenting on the new program, which will be inaugurated by members of this year's incoming freshman class, Dr. Halford declared that "it will serve uniquely an acute national interest:

"It is unnecessary to repeat the warnings that are being sounded almost daily concerning the severe shortage of research scientists in America and its grave consequences for national health, welfare, and security. Even more important is the need to have some superlative scientists who are also broadly educated men. Science has acquired an enormous leverage today in all human affairs. Men who make decisions of the highest import for our social, economic, and political welfare are often woefully ignorant in matters of science. Men who have mastered science are too frequently ignorant in the other areas of mankind's total experience and often are unable to comprehend or to communicate in nonscientific terms the significance of their expertness to the total picture. Professional societies in the sciences and the fields of engineering plead with our educational institutions to include more instruction in the humanities as part of science and engineering education.

"Institutions devoted primarily to science and engineering education," Dr. Halford said, "respond by creating departments of humanities; but a dilemma persists: How can they increase the breadth of total education without sacrificing a necessary depth of science and engineering education? How can they create at technical institutes high-level departments staffed with outstanding authorities in the social sciences and the humanities?

"For the exceptionally prepared, science-oriented students who would enter Columbia College with advanced standing there is no dilemma. Columbia College can offer to these talented students an educational opportunity that is unsurpassed, perhaps even unparalleled, in its combination of available breadth with available depth. The traditional Columbia College program is outstanding for its emphasis upon the humanities and the social studies. In the science departments, Columbia College students are taught by, and can enjoy intimate contact with, numerous members of the University's Graduate Faculties who are world-renowned authorities in their various specialties."

In conclusion, Dr. Halford declared that "experience with the College Board advanced placement program reveals the existence of a group of high schools that prepares talented students to begin college work at advanced levels. The new Columbia College program has been devised to enable these exceptionally prepared high school graduates to capitalize on their high school background."

## Southern Regional Graduate Summer Session in Statistics

The 5th Southern Regional Graduate Summer Session in Statistics will be held June 16-26, 1958, at Oklahoma State University, Stillwater, Okla. The summer sessions are rotated annually among the following institutions: Virginia Polytechnic Institute, Oklahoma State University, University of Florida, and North Carolina State College.

The program may be entered at any session, and consecutive courses will be offered in successive summers. The summer work in statistics may be applied toward residence requirements at any one of the co-operating institutions, as well as certain other institutions, in partial fulfillment of residence requirements for graduate degrees. Each annual summer session lasts six weeks and the several courses offered carry three semester hours of graduate credit.

The summer sessions are designed to carry out a recommendation of the Southern Regional Education Board's Committee on Statistics, on which the four institutions initiating the program are represented.

The sessions will be of particular interest to (1) research and professional workers who want intensive instruction in basic statistical concept and who wish to learn modern statistical methodology, (2) teachers of elementary statistics courses who want some formal training in modern statistics, (3) prospective candidates for graduate degrees in statistics, (4) graduate students in other fields who desire supporting work in statistics, and (5) professional statisticians who wish to keep informed of advanced specialized theory and methods.

The faculty for the 1958 Summer Session at Oklahoma State University will include the following visiting professors: H. O. Hartley, Statistical Laboratory, Iowa State College; W. T. Federer, Biometrics Unit, Cornell University; J. E. Freund, department of mathematics, Arizona State College; A. W. Wortham, operations research department, Texas Instruments, Dallas, Texas.

The local staff includes: C. E. Marshall (Ph.D., Iowa State); Franklin Graybill (Ph.D., Iowa State); R. D. Morrison (Ph.D., North Carolina State); John Hamblen (Ph.D., Purdue); Roy Deal (Ph.D., University of Oklahoma); and John Hoffman (Ph.D., University of Oklahoma).

Of particular interest at this summer session will be the six weekly symposiums covering six important areas in statistics. They are: sampling survey designs, experimental designs, nonparametric statistics, response curves and surfaces, multiple comparisons, and high speed computing. Discussants will be selected from major contributors to these areas. These invited speakers together with the outstanding summer school staff will cover the respective subjects from three points of view: applications, their mathematical bases, and the problems that lie on the frontier.

Inquiries should be addressed to C. E. Marshall, director, Statistical Laboratory, Oklahoma State University, Stillwater, Okla.

## Prof. Tuve Receives ASHAE Award

G. L. Tuve, professor of mechanical engineering and director of Bingham Laboratories, Case Institute of Technology, Cleveland, Ohio, was named to receive the 16th award of the F. Paul Anderson Medal from the American Society of Heating and Air-Conditioning Engineers (ASHAE) it was announced by President P. B. Gordon, New York, N. Y.

Presentation of the medal took place during the annual banquet, January 29, 1958, which concluded the 64th Annual Meeting of the ASHAE at Pittsburgh, Pa.

Because Professor Tuve has distinguished himself in the teaching profession and as a consulting engineer, he was selected to receive this highest award of the ASHAE in recognition of outstanding work in heating, ventilating, cooling, and air conditioning.

## Scholarship Fund for Japanese Students

Frank Pace, Jr., president of International Golf Association, has announced that the proceeds of $10,000 from the fifth International Golf Championship and Canada Cup Matches, held during 1957 in Tokyo, Japan, will be set aside to establish a scholarship fund for Japanese students to study nuclear science at universities in the United States.

The establishment of this scholarship fund was the result of an agreement between Mr. Pace and Matsutaro Shoriki, owner and president of the Yomiuri Shimbun newspapers, which cosponsored the event with the Japan Golf Association.

The International Golf Association, founded to promote international good will through golf, attracted 30 countries to the event. The Canada Cup was won by Japan's team of Torakichi (Pete) Nakamura and Koichi Ono. Sam Snead and Jimmy Demaret of the United States finished second. The International Golf Trophy for the low 72-hole individual score was won by Nakamura.

## AIEE–IRE Auxiliary at University of Alabama

The Auxiliary to the Student Branch of the AIEE–Institute of Radio Engineers (IRE) at the University of Alabama was organized on October 16, 1957.

At this organization meeting, 30 prospective members were present. Mrs. Sarah Healy, dean of women at the University, served as temporary sponsor and plans were made to elect officers and secure a permanent sponsor.

The constitution was presented to the Student Legislature and the Committee on Student Campus Life for approval, and the Auxiliary was granted recognition on December 11, 1957. Mrs. W. J. Miller graciously consented to sponsor the Auxiliary for the academic year 1957-58.

The purpose of forming an Auxiliary is to promote the interests of the AIEE-IRE, and to enhance relations between the University of Alabama and the Branch.

Since the organization date, the Auxiliary has spent a great deal of time planning for the future. However, it has had the pleasure of having the wives of the faculty of the electrical engineering department as guests at a business meeting, and recently the Auxiliary entertained the faculty of the College of Engineering at a tea. Programs have been planned for the balance of this year which should prove to be both interesting and informative.

To date, there are 36 members in good standing. This figure is out of a possible membership of 48.

The AIEE-IRE Joint Student Branch at Alabama also has been busy. In addition to its regular monthly meetings, the branch has gone on its annual inspection trip, visiting Hayes Aircraft Corporation of Birmingham and The Alabama Power Company's Gorgas Steam Plant at Gorgas, Ala. A "Ladies Night" was held in November 1957 at the Wesley Student Center on campus. The Student Branch was host to the Alabama Section of AIEE in December, and the Section planned to reciprocate in February. The Section annually sponsors a Student Branch paper competition and they were to present awards at this meeting.

## College of Engineering To Be Established at Rochester

The University of Rochester (U of R) has announced the establishment of a College of Engineering as one of three new professional units under a major reorganization of its academic and administrative subject, effective September 1, 1958.

The new college will combine the long-established departments of chemical and mechanical engineering, and the new department of electrical engineering. It will have its own dean and administrative staff and will have the full freedom of action necessary to its best professional development, it is stated by Dr. C. W. de Kiewiet, president of the U of R. The appointment of a new dean will be announced later.

Engineering has a solid foundation at the U of R, where courses in that field were inaugurated in 1910. Since then, some 1,500 graduates have received engineering degrees. In an article in *Mechanical Engineering* on "A Study of College Graduates in the 1954 Edition of *Who's Who in Engineering*," the University of Rochester was listed as third in the nation in the percentage of the total engineering alumni who are listed in *Who's Who in Engineering*.

Present enrollment in chemical, mechanical, and electrical engineering courses is about 300, approximately 25% of the undergraduate men students in the College of Arts and Science.

The U of R is steadily expanding its undergraduate enrollment, with the expectation that it will reach 2,500 by 1965. With the growth in the student body, it is expected that the number of engineers will double within the next 10 years.

The U of R offers 4-year accredited courses in chemical, mechanical, and electrical engineering leading to the B.S. degree with field specification. About one fourth of the time is devoted to work in the humanities and social studies, and the remainder in the basic sciences and engineering studies. Each curriculum is based on a foundation of mathematics, physics, chemistry, and certain basic engineering studies.

The emphasis is placed on a thorough understanding of the fundamental principles of science and engineering, rather than on a detailed knowledge of specific engineering practice. The aim is to prepare the engineering graduate for industrial employment or other professional engineering service, or for study beyond the bachelor's degree. Although the undergraduate programs are normally completed in four academic years, an engineering

**OFFICERS of the Auxiliary of the AIEE–IRE Student Branch at the University of Alabama are:** *(seated, left to right)* **Mrs. Judson Lovingood, secretary; Mrs. Walton Avinger, vice-president; Mrs. M. E. Cash, president; Mrs. W. J. Miller, sponsor; Mrs. Alfred McKenzie, parliamentarian; and Mrs. C. D. Smith, Jr., treasurer.**

# Electrical Engineering Education

student may obtain permission to extend his undergraduate work over a 5-year period, giving him extra time to broaden his formal education by including additional courses in the liberal arts or in sciences.

The other two new professional units at the University of Rochester are a College of Education and a School of Business Administration. They bring to a total of six the number of separate schools and colleges at the River Campus, including the College of Arts and Science, founded in 1850, University School of Liberal and Applied Studies, and the unique Institute of Optics.

## New Sound-Slide Film Programs Available

The AIEE Student Branches Committee announces the availability of two new sound-slide film programs. These are: Program No. 1—"Atomic Energy Challenges the Electrical Engineer." This program was sponsored by the General Electric Company with Francis McCune, vice-president and general manager of Atomic Products Division, as the narrator. This slide film depicts some of the areas in which electrical engineers have made and will continue to make contributions to progress in the field of atomic energy.

Program No. 2—"Kilowatt Insurance." This program was sponsored by the Allis-Chalmers Manufacturing Company and is narrated by J. B. Hodtum, manager of central station engineering, Pittsburgh Works.

Detailed information on these programs will be circulated to the Branches in the near future. However, any Branch interested in arranging an immediate showing should contact J. S. Antel, Jr., 7113 Central Ave., Takoma Park, Md. The proposed date for showing the program and the person to whom it is to be shipped, should be given in the requesting letter.

## AEC–ASEE Summer Institutes on Nuclear Energy

Nine Institutes on Nuclear Energy for engineering educators will be held throughout the United States this summer under the sponsorship of the Atomic Energy Commission (AEC) and the American Society for Engineering Education (ASEE).

The purpose of the institutes is to provide special training in the fields of nuclear energy and the nature of nuclear reactor problems so the teachers can incorporate this material in their teaching programs.

The 1958 institutes will include four basic courses for teachers with no special background in nuclear energy, four advanced-level courses, and one new basic course for teachers in technical institutes.

This program reflects a substantial increase in offerings since the courses were first offered in the summer of 1956. The first year, only two institutes were held, with an attendance of 90. In 1957, four were given, with 80 participants. The nine 1958 institutes will provide instructional capacity for more than 225 teachers who will be preparing themselves to participate in nuclear education programs for engineering students.

The AEC is investing approximately $400,000 in the operation. Applicants will be selected by subcommittees of the ASEE Nuclear Committee on the basis of the candidate's experience and the instructional use to be made of the training.

Participants will receive a minimum of two months' pay in addition to their regular salary for the academic year. For an applicant to be considered, the educational institution will be required to contribute to him a minimum of one month's salary. The AEC grant will match this contribution to a maximum of $750 plus round-trip railroad fare.

Applications for appointment may be obtained from the deans of engineering or from ASEE headquarters. They should be sent to Prof. W. L. Collins, Secretary of the ASEE, University of Illinois, Urbana, Ill.

Each of the basic institutes will be combined programs of a university and a national laboratory, with a quota of from 25 to 30 participants at each location. The dates for all are June 23–August 15 and the locations are: North Carolina State College, Raleigh, N. C., with Oak Ridge National Laboratory; Cornell University, Ithaca, N. Y., with Brookhaven National Laboratory; Purdue University, Lafayette, Ind., with Argonne National Laboratory; and University of California at Berkeley with Radiation Laboratory at Livermore.

The advanced institutes with quotas of from 20 to 25 participants will be as follows: Reactor Theory, University of Michigan, June 23–August 15; Reactor Instrumentation and Control, Argonne National Laboratory, June 23—August 15; Chemical Processing, Hanford Laboratories, June 22–August 15; and Nuclear Metallurgy, Ames Laboratory, June 30–August 22.

The course for teachers in technical institutes, with a quota of 25 participants, will be held at Pennsylvania State University June 30–August 8, and at Argonne National Laboratory August 11–August 22.

## Columbia Professor Wins Research Corporation Award

Dr. C. H. Townes, professor of physics at Columbia University, received the 1957 Research Corporation Award on January 23 for his work in microwave spectroscopy.

The award, consisting of an honorarium of $2,500, a plaque, and a citation, was presented to Dr. Townes by J. W. Barker, chairman of the board of Research Corporation, at a dinner at the Ambassador Hotel, New York, N.Y.

Dr. Townes' scientific research has: (1) provided a new order of accuracy in the measurement of time—a plus-or-minus one second deviation every 300 years; (2) produced amplifiers more than 100 times more sensitive than previously known types, expanding, for example, the range of radio astronomy by making it possible to pick up otherwise weak and inaudible signals; and (3) gained detailed information previously unknown on the structure of molecules, by measuring the frequencies to which they respond.

Dr. Townes, who has been teaching at Columbia since 1948, is the 22nd recipient since the award's inception in 1925.

## Intensive Course In Automatic Control

The University of Michigan College of Engineering has announced a summer Intensive Course in Automatic Control scheduled for June 16-25, 1958. The course is intended for engineers who wish to obtain a basic understanding of the field, but who cannot spare more than a few days for this purpose. The aim of the course is to make the subject matter easy to learn by a coherent presentation in class of the fundamentals of modern automatic control, and by providing a comprehensive set of notes which will serve as a framework for further study.

The course is built around the principles and application of measurement, communication, and control. The material will begin with the fundamentals in each of these fields and will include some basic work in nonlinear systems. This will be followed by applications of the fundamentals to more advanced problems. There will be four hours of lecture each morning and three hours of laboratory demonstration in the afternoon. Extensive use will be made of computing, instrumentation, and servo laboratories on the campus. The role of analog computing methods will be emphasized. This course has been given in the summers since 1953.

April 15 is the closing date for registration. Further information may be obtained by writing to Prof. L. L. Rauch, Room 1525 B, East Engineering Building, University of Michigan, Ann Arbor, Mich.

## NSF Appoints Dr. Fontaine Fellowship Program Director

The appointment of T. D. Fontaine as program director for fellowships, Division of Scientific Personnel and Education, was announced recently by A. T. Waterman, director of the National Science Foundation (NSF).

Dr. Fontaine, who has served for the past 2½ years as administrative assistant to Senator J. C. Stennis of Mississippi, was previously a research chemist with the Department of Agriculture.

A native of Utica, Miss., he received his undergraduate training at Mississippi College and earned his Ph.D. in chemistry at the University of Pittsburgh where he was a research fellow of the Mellon Institute.

Dr. Fontaine began his scientific career in 1941 as chemist with the Agricultural Research Service, Southern Utilization Research Branch in New Orleans, La. From 1945 to 1952, he was located at the Agricultural Research Center in Beltsville, Md. He was head of the Biologically Active Chemical Compounds Division there from 1948-1952, and served in the same capacity for three more years when the Division was moved to the Eastern Utilization Research Branch, Wyndmoor, Pa.

At NSF he will administer the fellowships program which provides support for graduate study and work in the sciences and mathematics for the purpose of increasing the supply and competence of research scientists and college science teachers. During the 1957 fiscal year, 1,109 such fellowships were awarded.

## Plan for Increasing Number of Engineering Teachers

A plan, submitted by The American Society for Engineering Education (ASEE), to increase the number of young teachers for engineering schools of the United States has been presented to Dr. J. R. Killian, Jr., Pres. Eisenhower's Special Assistant for Science and Technology.

In order to encourage more good students to enter graduate study, the period during which most engineering students discover their interest in a teaching career, the ASEE states that basic research in engineering must be expanded and that Federal agencies supporting basic research in engineering should greatly enlarge both the number and the amount of the grants. The increased amounts should cover adequately the true costs, including the portion of the faculty salaries required to direct the projects. The contracts also should be for longer periods of time, such as five years, and should provide means for the construction or enlargement of the buildings required.

With this as a fundamental premise, the four-point plan is:

1. A substantial increase in the number of National Science Foundation (NSF) fellowships for first-year graduate study in engineering.
2. A program of secondary grants to those who fail to qualify for full fellowships under the NSF program.
3. Supplementary Federal grants to holders of NSF fellowships who take part-time teaching assignments.
4. A new program of awards under the NSF to increase the financial aid to graduate students who combine teaching with their education and research experience.

ASEE calls particular attention to the important role of basic research in preparing engineering teachers. Federal support of basic research, the ASEE report states, ". . . will determine the supply of individuals with the requisite background to educate engineers in an age when basic understanding of scientific principles must replace dependence on intuition and experience."

Until very substantial steps are taken to relieve the critical shortage of teachers, efforts to increase undergraduate enrollments are "highly questionable," says the ASEE Committee on the Development of Engineering Faculties.

Already, the committee says, the United States faces a shortage of nearly 1,000 engineering teachers. About 9,500 new teachers will be required by 1966.

ASEE's program, says Dean W. L. Everitt, of the University of Illinois, who drafted the recommendations to Dr. Killian, represents "an evolutionary but not revolutionary change in present Federal policies.

"It would serve to increase the critically inadequate supply of well-educated engineers, and it would provide small additional incentives for a number of these to explore teaching careers."

Dr. F. C. Lindvall, president of the ASEE and chairman of the Division of Engineering at California Institute of Technology, points out that academic careers are not the traditional ones for engineering graduates as they have been for most scientists. Therefore, he says, "graduate students in our engineering colleges need every opportunity and encouragement to sample the satisfactions of teaching and the real excitement of fundamental research."

Dr. H. L. Hazen, dean of the Graduate School at the Massachusetts Institute of Technology and chairman of the ASEE Committee, emphasizes that "The primary need is for more of our ablest recipients of bachelor's degrees in engineering to enroll in our residential graduate schools. It is from these graduate schools that our engineering teachers come."

The supply of resident students depends chiefly upon support in the form of fellowships and assistantships, Dean Hazen believes.

"Resident" graduate work is emphasized by the committee because, its recommendations say, ". . . experience has shown that students who take graduate work on a part-time basis while employed in industry are almost never attracted to academic careers."

But many students who have an opportunity to teach engineering during their graduate years discover that they enjoy teaching and decide to make it their career. And all engineering educators agree that teaching is itself a most effective means of learning.

Indeed, say the committee's recommendations to Dr. Killian, every qualified engineering graduate student should have the opportunity and even obligation of assisting in his university's teaching program.

## Navy Promoting Program To Help Science Teachers

In an effort to further the increasing interest in science, the U. S. Naval Research Laboratory, Washington, D. C., is sponsoring an experimental series of seminars on basic science and engineering for local elementary, junior high, and senior high school teachers. The seminars, which have the over-all theme "Milestones in Science and Engineering," cover various topics in physics, chemistry, and mathematics, and show the interrelationship among these fields. Suggestions for classroom demonstrations and student projects, which can be accomplished with the minimum of materials, are expected to make the sessions informative and interesting to science and mathematics teachers. Following each seminar, the teachers will have an opportunity to discuss problems or ask questions.

"The Story of Crystals" was the subject of the first of these seminars. It was held on Saturday, February 15, 1958, and again on Monday, February 17. Identical programs are given on both Saturday morning and Monday evening to give all interested teachers an opportunity to attend. Another seminar was "Architecture of the Atom" on Saturday, March 8 and Monday, March 10.

Future seminars will include:

"The Heavens Around Us" on Saturday, April 19—9:00 a.m. to 12 Noon; and Monday, April 21—7:30 p.m. to 10:30 p.m.

"Understanding the Electron" on Saturday, May 17—9:00 a.m. to 12 Noon; and Monday, May 19—7:30 p.m. to 10:30 p.m.

Science and mathematics teachers interested in this program have been requested to submit a postcard form to the Naval Research Laboratory. This information may be obtained from their school principal's office or call the Naval Research Laboratory, Washington, D. C., JOhnson 3-6600, Ext. 2319.

## Giant Radio Telescope To Be Built at U of Michigan

A giant radio telescope that will follow the sun across the sky by day and catch signals from outer space by night will be built in June 1958 at The University of Michigan, Ann Arbor, Mich.

F. T. Haddock, associate professor of astronomy and of electrical engineering, said that the highly sensitive intrument will be erected at Peach Mountain, 16 miles from Ann Arbor.

Standing over 100 feet high, the instrument will have a solid "dish" reflector 85 feet in diameter. The device will require 160 tons of steel and aluminum, 50 tons of lead counterweight, and 250 cubic yards of concrete foundation, Prof. Haddock said.

In addition to being the second largest steerable radio telescope in the world, it will be one of the most precisely made, Prof. Haddock pointed out.

"With this instrument," he said, "we will be able to receive radio waves only a few centimeters long, and to focus on only 3% of the sun's surface at a time. This is fine detail, and will put us far ahead in the field."

The "dish" will be able to pick up the short wavelengths because of its precise

# Electrical Engineering Education

construction. The surface will not vary more than a quarter inch from a true parabola. The larger diameter will allow University of Michigan researchers to collect fainter signals, and to "look at" smaller portions of radio sources, and the dish's solid aluminum surface will prevent the leakage of signals at all wavelengths.

The complete facility will cost about $300,000, Prof. Haddock said, with most of the money supplied by the Office of Naval Research.

The new telescope will join a 28-foot unit placed in daily automatic operation at Peach Mountain in August. The smaller unit already has recorded some "new and unusual" signals from the sun, Prof. Haddock said.

In addition to receiving solar signals, the newer instrument will hear the faint whispers from the moon, planets, galaxies millions of light years away, turbulent gas clouds, "radio stars," and other sources, some possibly beyond the range of the best optical telescopes, he added.

These signals are produced by the interaction of electrons with atomic particles or magnetic fields, and yield data about the regions in which they originate.

Two large gears will drive the University of Michigan dish. A declination gear will tilt it north and south, and an hour-angle gear will move it east to west to compensate for the earth's rotation. It will be possible for the unit to follow a sunspot or solar flare region all day, or to execute "elaborate scanning operations," Prof. Haddock said.

He noted that the telescope would be operated in winds as high as 45 mph, and would survive 120 mph winds.

Prof. Haddock pointed out that the dish will work at wavelengths 5 to 10 times shorter than the world's largest "dish"—a 250-foot unit in England.

"Major advances in radio astronomy in the future are likely to come in the centimeter wavelengths," he said. "This new dish will have three times the collecting area of any other in its class."

There are other types of radio telescopes which stretch out for hundreds of yards. They provide a high degree of resolution, but cannot be moved to follow radio sources or the sun for many hours at a time.

## Firms Aid University To Obtain Scientific Equipment

Two industrial firms have gone to the aid of the University of Colorado in obtaining urgently needed scientific equipment, President Quigg Newton announced recently.

As a result, the University will receive thousands of dollars of electronic and measuring equipment for use in physics laboratory instruction at a cost of only $1,300 to the institution, President Newton said.

Acquisition of the equipment is being made possible through the General Electric Company's (GE) educational assistance program and a $5,000 grant from the Carl A. Norgren Foundation, Englewood, Colo.

Several months ago GE agreed to provide the University with 195 pieces of badly needed instructional equipment if the University could put up $6,300—a fraction of the total cost.

Because of budget limitations, the University could allot only $1,300 for the equipment, and was about to turn down the offer when C. A. Norgren, president of the foundation and pneumatic products firm bearing his name, volunteered to make up the difference.

GE's contribution is part of its educational assistance program, through which it supplies essential equipment to colleges and universities that are unable to pay the full cost of the material, according to G. L. Irvine, GE commercial vice-president.

Dr. A. B. Weaver, chairman of the University of Colorado physics department, said the equipment the University will be receiving includes 10 oscilloscopes, 4 photoelectric recorders, and various other urgently needed electronic instruments and meters.

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## New AIEE Members

**ALL 32 MEMBERS** of the graduating class, receiving B.S. degrees in electrical engineering, communications, December 19, 1957, at the Milwaukee School of Engineering, have become members of the AIEE. Pictured above are: *(left to right, top row)* W. P. Kapros, J. R. Dettman, J. P. Lange, D. M. Gilbert, R. J. Folmar, L. G. Baron, L. H. Schramm, W. H. Peters, S. D. Russell, Jr., R. K. Dohlem, M. I. Beane, N. L. Jacques; *(middle row)* F. W. Bird, B. C. Miller, R. H. Dobberstein, R. L. Jude, R. F. Workman, J. O. Boutelle, W. J. McRae, R. D. Benedict, R. L. Bilodeau, E. E. Jesse; *(bottom row)* W. P. Hansen, Jr., J. P. Crotty, E. C. Christenson, P. E. Belcher, Noah Flueckiger, J. C. Hand, and K. R. Bassman. Not pictured are: J. I. Kolb, Harvey Michalski, and C. C. Williams.

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## $35,000 Gift Establishes Stewart J. Cort Fund at Lehigh

A gift of $35,000 as an endowment fund for scholarship aid at Lehigh University from S. J. Cort, retired vice-president of the Bethlehem Steel Company, was announced recently by E. W. Glick, University treasurer.

Mr. Cort, a graduate of the electrometallurgical curriculum in the class of 1906 at Lehigh University has been a member of the University's board of trustees since 1942, serving on the executive committee and the buildings and grounds committee. He received the honorary degree of doctor of engineering from Lehigh in 1948.

Income from the fund, which the trustees have designated as the Stewart J. Cort Fund, is to be used for awarding scholarships. The recipient shall be a candidate for admission to the College of Engineering at Lehigh University, preferably in the metallurgical engineering curriculum or in the combined arts-metallurgy program.

The basis for the award shall be financial need, high scholastic achievement, character, personality, and leadership qualities. The amount of each award will be dependent on the income that is available from the fund.

With these limitations, the University's committee on scholarships and loans may award an amount not less than $200 and not more than $2,000 dependng upon the financial need of the candidates.

# INSTITUTE ACTIVITIES

## Washington, D.C., Will Again Be Host to AIEE Middle Eastern District Meeting

WASHINGTON, D.C. will again be host to the AIEE Middle Eastern District Meeting, April 28-30, 1958, with headquarters in the Sheraton Park Hotel. "Engineering in the Nation's Capital" has been selected as the theme of the meeting which will feature technical sessions of interest to everyone. Social events will be outstanding. Inspection trips of unusual interest have been arranged.

### General Session

The general session will open the meeting and will be called to order in Sheraton Hall at 10 a.m., Monday, April 28, by Presiding Chairman C. H. Giroux, general chairman of the District No. 2 Meeting. Welcoming remarks will be extended by Col. A. C. Welling, engineer commissioner for the District of Columbia. The principal speaker will be **Dr. L. V. Berkner** who is a fellow of the Institute and a member of many other scientific societies, unions, and academies. Currently, he is president, member of the board of trustees, and chairman of the Executive Committee of Associated Universities, Inc., in New York, N.Y. He has been a prime mover in the International Geophysical Year which makes him extremely well qualified to have as his subject "The International Geophysical Year and the Instrumented Earth Satellite."

### Registration

Advance registration cards should be mailed to W. J. Ellenberger, chairman of the Registration Committee, 6419 Barnaby Street, N. W., Washington 15, D.C. in order to avoid delay. Members may pay registration fees upon arrival when they pick up identification badges, programs, etc. The Registration Desk, in the east lobby of the Sheraton Park Hotel, will be open Sunday afternoon, April 27, for those arriving early, and daily thereafter during the meeting.

### Hotel Reservations

It is suggested that room reservations at the Sheraton Park Hotel be made promptly as April is Cherry Blossom Time in Washington and the tourist season will be well under way. Rates are as follows:

| | | | | | |
|---|---|---|---|---|---|
| Single with bath | $ 8 | $ 9 | $10 | $11 | $12 |
| Twin with bath | 11 | 12 | 13 | 14 | 16 |
| Suites: 2 rooms | | 20 | 22 | 25 | 30 |
| Suites: 3 rooms | | 40 | 45 | 50 | 60 |

No room charge for children under 14 years, occupying room with their parents.

Contact Reservations Manager, Sheraton Park Hotel, Washington 8, D.C., giving room choice, time of arrival, and time of departure. Be sure to mention AIEE.

### Exhibits

You will certainly want to be a frequent visitor to the interesting exhibits which are being displayed. They are located in the Exhibition Hall of the hotel. Exhibit hours are: Monday, 10 a.m.-6 p.m.; Tuesday, 9 a.m.-6 p.m.; Wednesday, 9 a.m.-5 p.m.

### Smoker

On Monday evening, April 28, at 7 p.m., the smoker will open in Exhibit Hall N with a dutch-treat social hour followed by dinner and entertainment. For this social evening tickets are $8 per person and will be available at the registration desk.

### Dinner-Dance

The social hour will open the dinner-dance at 6 p.m. on Tuesday, April 29, in the Sheraton Hall on a dutch-treat basis. Dinner at tables for eight will be served from 7-9 p.m. Dancing follows until midnight. Entertainment including Arthur Murray dancers will be provided. Tickets are $7.50 per person and will be available at the registration desk. Dress will be optional.

### Ladies Entertainment

The following schedule of events should provide the ladies with reasons for accompanying their husbands to the District Meeting:

**Monday (Total Price $4.25)**

Morning—Registration; Coffee hour in hospitality suite

Afternoon—Blossomtime Tour, 2 hour sightseeing drive

Dinner—Dutch-treat at restaurant of choice, French, Chinese, Mexican, Swedish, or American

Evening—Ladies Party in Caribar Room; Bridge, Canasta, prizes, refreshments

**Tuesday (Total Price $7.00 Dinner Dance not included)**

Morning—Coffee hour, Special visit to the White House

Noon—Luncheon at Little Tea House in Virginia

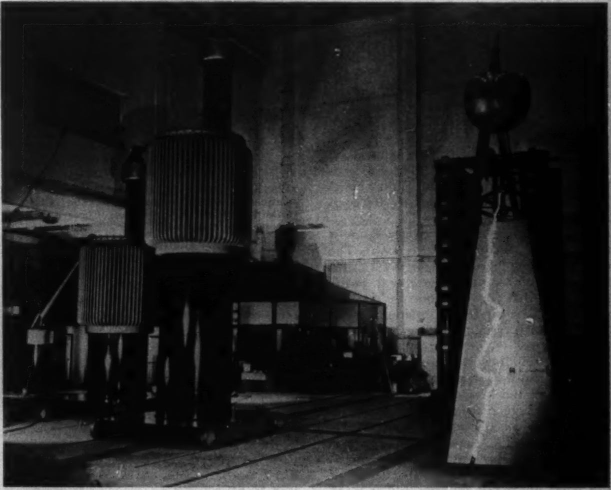
Afternoon—Embassy Tea

Dinner and Evening—Dinner Dance (with husbands)

**Wednesday (Total Price $3.75)**

Morning—Coffee hour

Noon—Luncheon at Shoreham Hotel with lecture and demonstration of flower arrangements



**LIGHTNING FLASH, 12-feet-long, discharged from the National Bureau of Standards' 2 million volt surge generator is guided by a conducting channel painted on the surface of a plywood glider rudder. An inspection trip to the National Bureau of Standards is planned during the AIEE Middle Eastern District Meeting.**

**Special price for all three days events—$13.50**

Please mark your advance registration card so that suitable arrangements can be made.

### Inspection Trips

A program of inspection trips of both technical and general interest has been arranged for those attending the District Meeting. Since the number of persons who may be accommodated on each of these trips is limited, members who are interested are urged to make an advance registration and obtain full details at the Inspection Trips Desk immediately after arrival. Buses will leave from in front of the hotel at 9 a.m. for morning trips and 2 p.m. for afternoon trips.

On some of the trips, proof of U. S. Citizenship will be required, and members should be prepared to comply with such security regulations as may be in force at the time of the trip.

*The National Bureau of Standards, Washington, D.C.* (Monday afternoon and Tuesday afternoon). This visit to the NBS laboratories will feature current programs in the physical sciences with special emphasis on (1) improving and extending the standards of electrical measurement; (2) high-voltage surge measurements; (3) radiation research and standards; (4) electronic instrumentation as demonstrated by FOSDIC III, an information retrieval device; (5) the use of advanced data processing techniques and simulation by computer; (6) development of mechanical performance criteria for electric and telephone distribution systems; and (7) the properties of materials at high temperatures: the solar furnace. Capacity 150 each day. Bus fare $1.50 round trip.

*Naval Ordnance Laboratory, White Oak, Md.* (Wednesday morning and afternoon). This is a primary research and development activity of the Bureau of Ordnance. Visitors will see the Magnetic Materials Laboratory where basic research has developed many nonstrategic materials for magnet purposes, the Ships Model Magnetic Measurements Laboratory where the earth's magnetic field can be neutralized and other fields simulated. The Environmental Laboratory and the wind tunnel will also be of interest. Capacity 100 each day. Bus fare $1.50 round trip.

*Army Package Power Reactor, Fort Belvoir, Va.* (Wednesday afternoon). The Army Package Power Reactor is termed a "package" power plant because it is designed so that its components may be transported by air for installations at remote military installations, such as arctic bases.

Visitors will be given a description of the plant and its capabilities and small groups will be conducted through the control and generating rooms. Capacity 150. Bus fare $2.00 round trip.

*New WRC-TV Transmitter, Washington, D.C.* (Tuesday and Wednesday morning). This latest type transmitter has all of the latest automatic features and is rated 20-kw FM and 100-kw television. The new studios have been especially designed for color. A splendid picture is assured by the new antenna which reaches 459 feet above ground level. The complete station is well worth seeing. Capacity 100 each day. Bus fare $1.50 round trip.

*David Taylor Model Basin, Carderock, Md.* (Tuesday afternoon). There will be a 20-minute movie followed by a tour of the deep-water and high-speed towing basin, which is almost 3/5 of a mile long; a shallow-water and turning basin; a circulatory-water channel; two variable-pressure water tunnels; subsonic, transonic, and supersonic wind tunnels; two Univacs; and other facilities. Capacity 150. Bus fare $1.50 round trip.

### Committee

Members of the Middle Eastern District Meeting Committee are: C. H. Giroux, general chairman; F. W. Willcutt, vice-chairman; J. E. O'Brien, secretary; D. E. Bender, treasurer; T. A. O'Halloran, arrangements; G. E. McCabe, finances; W. J. Ellenberger, registration; S. E. Jarosh, technical program; Gravatt and Coleman, inspection trips and transportation; Ralph Siegel, entertainment; Mrs. N. B. Ames, ladies; Dr. N. B. Ames, general session; I. F. Conrad, publicity.

### Mailed Announcement

A mailed announcement of this meeting will be sent to members in District No. 2. If a copy is desired by members in other Districts, please write to E. C. Day, Assistant Secretary for Technical Papers and Programs, TOD, American Institute of Electrical Engineers, 33 W. 39th St., New York 18, N. Y.

The tentative technical program for the District Meeting follows.

## Monday, April 28

### 9:00 a.m. General Session

### 2:00 p.m. Communications—Burgundy East Room

Moderator—H. P. Howard, The Chesapeake & Potomac Telephone Company

**DP58-536 Experience with Long Distance Television Fields Used for Re-Transmission.** *W. L. Braun,* Rockingham Construction Company, Inc.

**DP58-537 Dial Telephone Service for Smith Island—Isolated Community in the Chesapeake Bay.** *M E. Littleton,* Chesapeake & Potomac Telephone Co.

**DP58-538 The Analysis of Redundancy Networks and Functions.** *Fred Moskowitz,* Rome Air Development Center, Griffiss Air Force Base

**DP* Explorations of Physical Phenomena for Communications.** *J. L. Ryerson,* Rome Air Development Center, Griffiss Air Force Base

### 2:00 p.m. Transmission and Substation—Burgundy West Room

Moderators—D. F. Hughes, Potomac Electric Power Company; K. J. Plucknett, Department of Interior

**DP58-539 Design and Operation of Reclamation's Power Systems.** *D. S. Campbell,* Bureau of Reclamation

**58-540 A Pattern for Calculating Transmission Line Tower Foundations.** *E. Fritz,* Potomac Electric Power Company

**DP* 69-Kv Pipe Cable Installation.** *L. H. Spangler,* Potomac Electric Power Company

**DP* Large Downtown Substation.** *M. L. Byrne,* Potomac Electric Power Company

### 2:00 p.m. Instrumentation—Madison Room

Moderator—F. B. Silsbee, National Bureau of Standards

**58-541 Magnetic-Amplifier Operated Ink Recorders** *W. A. Geyger,* Naval Ordnance Laboratories

**DP58-542 Intercomparison of the Ranges on Multirange Wattmeters.** *R. J. Rowsome,* The Detroit Edison Company

**DP58-543 Instrument Evolution as It Affects Readability and Utility.** *L. J. Lunas,* Westinghouse Electric Corporation

**DP58-544 The Verification and Guarantee of the Class Accuracy of Precision Wattmeters at Power Frequency.** *G. Induni,* Trüb Taüber & Co.

**DP58-545 A Light Pointer-Type Electrostatic Voltmeter for 150 Volts.** *G. Induni,* Trüb Taüber & Co.

### 2:00 p.m. Naval Testing—Caribar Room

Moderator—C. R. Hirschberger, David Taylor Model Basin

**DP58-546 The Effects of Underwater Explosions on Shipboard Equipment.** *H. L. Rich,* David Taylor Model Basin

**DP58-547 Test Measurement of Power, Speed, and Thrust on Naval Vessels.** *B. E. Bayles, Q. R. Robinson,* David Taylor Model Basin

**DP* An Analog Computer Study of Programmed Parallel-Fed Variable Frequency Induction Motors with Large Load Disturbances.** *S. E. Dawson,* David Taylor Model Basin

**DP58-548 Differential Reluctance Measuring System and Its Application to Model and Ship Testing.** *M. W. Wilson,* David Taylor Model Basin

### 2:00 p.m. Illumination—Franklin Room

Moderator—H. A. Friede, District of Columbia Government

**58-549 An Analysis of Visual Elements in Roadway Lighting.** *W. H. Edman,* Holophane Company

**DP58-550 Some Aspects of Roadway Illumination.** *J. W. Young,* Lighting Consultant

**DP58-598 New Development in Light Sources and Optical Systems for Roadway Lighting.** *E. B. Karns,* Westinghouse Electric Corporation

**DP* Providing Illumination Along the New Super Highways.** *Walter Schwanhausser,* General Electric Company

## Tuesday, April 29

### 9:00 a.m. Communications—Burgundy East Room

Moderator—C. M. Braum, Joint Council on Educational Television

**DP58-596 Television Coverage of a Presidential Inaugural.** *P. F. Crabill, Jr.,* The Chesapeake & Potomac Telephone Company

**DP* New Transmitter and Studios for WRC-TV.** *J. G. Rogers,* WRC-TV

**DP* The TASO Field Strength Measurements and Analysis Program, A Progress Report.** *H. T. Head, H. Fine,* TASO

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* District Papers will not be printed by the Institute; however, they may be available at the meeting at the discretion of the author.

# AIEE Future Meetings

**AIEE-ASME-IRE-ISA-AIChE Automatic Optimization Conference***
University of Delaware (Dormitory Accommodations)
Newark, Del.
April 2-4, 1958

**AIEE-ASME Railroad Conference***
Statler Hotel
Cleveland, Ohio
April 9-10, 1958

**Rubber and Plastics Conference***
Mayflower Hotel
Akron, Ohio
April 14-15, 1958

**AIEE-IRE-ASME Automatic Techniques Conference (Automation and Data Processing)***
Statler Hotel
Detroit, Mich.
April 14-16, 1958

**AIEE-IRE-EIA-WCEMA Joint Electronic Components Conference***
Ambassador Hotel
Los Angeles, Calif.
April 22-24, 1958

**Middle Eastern District Meeting***
Sheraton-Park Hotel
Washington, D.C.
April 28-30, 1958

**Great Lakes District Meeting***
Kellogg Center
Michigan State University
East Lansing, Mich.
May 5-7, 1958

**AIEE-IRE-ACM Western Joint Computer Conference (Exhibit)***
Ambassador Hotel
Los Angeles, Calif.
May 6-9, 1958

**East Central District Meeting***
Prichard Hotel
Huntington, W. Va.
May 13-15, 1958

**Vermont Subsection-U of Vermont Power System and Computer Symposium***
University of Vermont
Burlington, Vt.
May 15-16, 1958

**Materials Handling Conference***
Penn-Sheraton Hotel
Pittsburgh, Pa.
May 19-20, 1958

**Appliance Technical Conference***
Hotel Morrison
Chicago, Ill.
May 26-27, 1958

**AIEE-ISA-IAS-ARS National Telemetering Conference (Exhibit)***
Lord Baltimore Hotel
Baltimore, Md.
June 2-4, 1958

**Summer General Meeting**
Hotel Statler
Buffalo, N. Y.
June 22-27, 1958
*(Final date for †TP—Closed, ‡CP Syn.—April 3, CPMs—April 7)*

**AIEE-IRE Nonlinear Magnetics and Magnetic Amplifiers Conference (Exhibit)**
Statler Hotel
Los Angeles, Calif.
August 5-8, 1958
*(Final date for †TP—April 25, ‡CP Syn.—May 20, CPMs—May 30)*

**AIEE-IRE-NBS Electrical and Radio Standards Conference**
University of Colorado and NBS (Dormitory Accommodations)
Boulder, Colo.
August 13-15, 1958
*(Final date for †TP—May 5, ‡CP Syn.—May 30, CPMs—June 9)*

**Pacific General Meeting**
Hotel Senator
Sacramento, Calif.
August 19-22, 1958
*(Final date for †TP—May 9, ‡CP Syn.—June 3, CPMs—June 6)*

**Petroleum Industry Conference**
Baker Hotel
Dallas, Texas
September 15-17, 1958
*(Final date for †TP—June 6, ‡CP Syn.—July 1, CPMs—July 11)*

**Power Industry Computer Application Conference**
King Edward Hotel
Toronto, Ont., Canada
September 15-17, 1958
*(Final date for †TP—June 6, ‡CP Syn.—July 1, CPMs—July 11)*

**AIEE-IRE Industrial Electronics Conference**
Rockham Memorial Auditorium
Detroit, Mich.
September 24-25, 1958
*(Final date for †TP—June 16, ‡CP Syn.—July 11, CPMs—July 21)*

**AIEE-IRE-ASME National Power Conference**
Statler Hotel
Boston, Mass.
September 28-October 1, 1958
*(Final date for †TP—June 20, ‡CP Syn.—July 15, CPMs—July 25)*

**AIEE-IRE-EIA-SMPTE National Electronics Conference**
Hotel Sherman
Chicago, Ill.
October 13-15, 1958
*(Final date for †TP—July 4, ‡CP Syn.—July 29, CPMs—Aug. 8)*

**Machine Tools Conference**
Statler Hotel
Hartford, Conn.
October 13-15, 1958
*(Final date for †TP—July 4, ‡CP Syn.—July 29, CPMs—Aug. 8)*

**Fall General Meeting**
Penn-Sheraton Hotel
Pittsburgh, Pa.
October 26-31, 1958
*(Final date for †TP—June 27, ‡CP Syn.—Aug. 4, CPMs—Aug. 8)*

**Magnetism and Magnetic Materials Conference**
Sheraton Hotel
Philadelphia, Pa.
November 17-20, 1958
*(Final date for †TP—Aug. 8, ‡CP Syn.—Sept. 2, CPMs—Sept. 12)*

**AIEE-IRE-ACM Eastern Joint Computor Conference (Exhibit)**
Bellevue-Stratford Hotel
Philadelphia, Pa.
December 3-5, 1958
*(Final date for †TP—Aug. 25, ‡CP Syn.—Sept. 19, CPMs—Sept. 29)*

**AIEE-IRE Global Communication Systems Conference**
Colonial Inn-Desert Ranch
St. Petersburg, Fla.
December 3-5, 1958
*(Final date for †TP—Aug. 25, ‡CP Syn.—Sept. 19, CPMs—Sept. 29)*

**AIEE-IRE-ASQC-EIA National Symposium on Reliability and Qualtiy Control**
Bellevue-Stratford Hotel
Philadelphia, Pa.
January 12-14, 1959
*(Final date for †TP—Oct. 3 ‡CP Syn.—Oct. 27, CPMs—Nov. 7)*

**Winter General Meeting**
Statler Hotel
New York, N. Y.
February 1-6, 1959
*(Final date for †TP—Oct. 14, ‡CP Syn.—Nov. 3, CPMs—Nov. 7)*

**South East-South Central District Meeting**
Atlanta, Ga.
April 8-10, 1959
*(Final date for †TP—Dec. 27, DPMs—Jan. 12)*

*Final date for submitting papers—closed
**†TP—Transactions Paper**
**‡CP Syn.—Conference Synopsis**
**CPMs—Conference Manuscript**
**DPMs—District Manuscript**
**(District Paper Synopses should be directed to the District Meeting Committee)**

**Transactions and conference papers must conform to the requirements in *Authors Guide*.**
**For a copy, write to E. C. Day, AIEE, 33 W. 39th St., New York 18, N.Y.**

**DP*** **Surveys of Television Reception at VHF and UHF.** *W. L. Hughes,* Iowa State College

### 9:00 a.m. Nuclear Engineering—Burgundy West Room

Moderator—H. G. Hembree, Atomic Energy Commission

**DP*** **Basic Nuclear Engineering Concepts.** *H. Schwartz,* Atomic Energy Commission

**DP*** **Progress in the AEC's Power Reactor Development Program.** *L. H. Roddis, Jr.,* Atomic Energy Commission

**DP*** **Economic Aspects of Safe Reactor Designs.** *O. G. Hanson,* Consolidated Edison Company of New York

### 9:00 a.m. Distribution Systems, Utility—Caribar Room

Moderator—W. J. Witte, Baltimore Gas & Electric Company

"Service Reliability and System Design"

**DP*** **Measuring and Comparing the Reliability of Distribution Systems.** *H. W. Dannatell,* Potomac Electric Power Company

**DP58-551** **Improving Continuity of Service on Overhead Distribution Systems.** *W. E. Wilkerson,* Baltimore Gas & Electric Company

**58-552** **Service Reliability for Rural Distribution Systems.** *L. B. Crann,* Rural Electrification Administration

**58-553** **Selection, Design, and Operation of 13.2/23 Kv, as a Distribution Voltage.** *N. H.* Erlandson, Carolina Power & Light Co.

**DP58-554** **Distribution Systems Growth in Northern Virginia.** *Henry Noble,* Virginia Electric & Power Co.

### 9:00 a.m. Instrumentation—Madison Room

Moderator—J. H. Miller, Weston Electrical Instruments Corporation

**DP58-555** **A Universal Volt-Ampere Converter for Current and Voltage Measurements.** *F. L. Hermach, E. Williams,* National Bureau of Standards

**58-556** **A Precision Guarded Resistance Measuring Facility.** *F. H. Wyeth, J. B. Higley, W. H. Shirk,* Leeds & Northrup Company

**DP58-557** **The Economic Aspects of Electrical Measurements in the Naval Ordnance Laboratory.** *W. A. Stoll,* Naval Ordnance Laboratory

**DP*** **Improved Bridge for the Measurement of Core Losses in Ferromagnetic Materials at High Flux Densities.** *W. P. Harris, I. L. Cooter,* National Bureau of Standards

**DP58-558** **A Method for Calibrating Alternating Voltage Dividers.** *C. B. Pinckney,* Hughes Aircraft Company

### 9:00 a.m. Naval Testing—Hamilton Room

Moderator—C. R. Hirschberger, David Taylor Model Basin

**58-559** **Selection of a Drive System for a Rotating Arm.** *H. E. Prucha,* David Taylor Model Basin

**DP58-560** **400-Cycle Frequency Deviation Detector.** *R. J. Flaherty, Jr.,* U. S. Naval Engineering Experimental Station

**DP58-561** **Testing Batteries for the Vanguard Satellite.** *W. H. Lucke,* Naval Research Laboratory

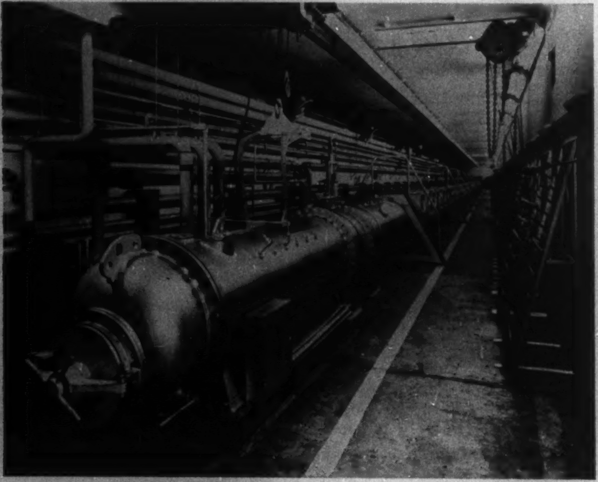
### 9:00 a.m. Automation—Franklin Room

Moderator—D. S. Bender, Bell Telephone Laboratories

**DP*** **Status Report on a Small Lot Printed.** *Stokes Burtis,* Radio Corporation of America

**DP*** **Automation in Electronics—The Second Step.** *R. L. Henry,* A.C.F. Electronics

**DP*** **New Developments in the Mini-Mech Systems for Automatic Component Assembly.** *A. A. Lawson, J. A. Hohos, R. Raynton,* Melpar, Inc.



*U. S. Naval Ordnance Laboratory, White Oak*

**PRESSURIZED BALLISTICS RANGE at Naval Ordnance Laboratory, White Oak, Silver Spring, Md., used to study flight characteristics of missiles under pressure up to six atmospheres, is 319 feet long, weighs approximately 100 tons, and has an inside diameter of 3 feet. Flight characteristics of the missile being tested are recorded from 25 photographic stations. The Naval Ordnance Laboratory will be visited during the AIEE Middle Eastern District Meeting.**

**DP*** **Cypak Automation on Industrial Lines.** *R. E. Giboney,* Westinghouse Electric Corporation

### 2:00 p.m. Communications—Burgundy East Room

Moderator—Robert Gartland, Chesapeake & Potomac Telephone Company

**DP*** **Practical Problems of Low-Level Speech Clipping.** *C. J. Affelder,* VOA-U.S. Information Agency

**DP*** **A Continuous Analysis Speech Bandwidth Compression System.** *S. J. Campanella, T. E. Bayston,* Melpar, Inc.

**DP58-562** **Bounds for Thermistor Matching.** *A. B. Soble,* Stevens Institute of Technology

**DP58-563** **Minimization of the Weight of Magnetic Cores and Coils.** *J. W. Kallander,* United States Naval Research Laboratory

### 2:00 p.m. Nuclear Engineering—Burgundy West Room

Moderator—W. R. Faust, Naval Research Laboratory

**DP*** **Design and Operation of the Army Package Power Reactor.** *K. Kasschau,* ALCO Products, Inc.

**DP*** **PAR–Penn Advanced Reactor Single Region Slurry System.** *Stanley Townsend,* Pennsylvania Power & Light Company

**DP*** **Control of Nuclear Reactors.** *E. P. Epler,* Oak Ridge National Laboratory

**DP*** **Basic Concepts of Thermonuclear Power.** *H. Roderick, Harold Morton, Jr.,* Atomic Energy Commission

### 2:00 p.m. Distribution Systems, Utility—Caribar Room

Moderator—G. C. McCabe, Potomac Electric Power Company

"Technical Operations and Practices"

**58-564** **Engineering Specifications for Wood Poles.** *L. G. Smith,* Baltimore Gas & Electric Company

**DP*** **Co-ordinated Physical Limits of Distribution.** *Harold Sangster, F. Slingluff,* Potomac Electric Power Company

**DP*** **Wind Inducted Vibration on Telephone and Distribution Conductor.** *A. A. Lee, C. P. Ballard,* United States Department of Agriculture; *R. R. Bouche,* National Bureau of Standards

**58-565** **Field Drying and Rehabilitation of Large Distribution Transformers.** *C. H. Smoke,* Norfolk Naval Facilities

**58-566** **Electrical Resistance to Grounding of Equipment Mounted on Wood Poles.** *H. E. Ziegenfuss, J. H. Winter, Jr.,* Baltimore Gas & Electric Company

### 2:00 p.m. Marine—Madison Room

Moderator—H. Coleman, Westinghouse Electric Corporation

**58-567** **Special Power and Lighting Systems on Aircraft Carriers.** *J. R. Cole, M. Garbacz,* Bureau of Ships, U. S. Navy Department

**DP58-568** **Use of Ungrounded Electrical Systems Aboard Naval Ships.** *C. L. Straub, E. W. Lusby,* Bureau of Ships, U. S. Navy Department

**DP58-569** **Electrical Installations in Nuclear Submarines.** *W. C. Whittenberg, W. H. Temple,* Bureau of Ships, U. S. Navy Department

### 2:00 p.m. Weapons Development—Hamilton Room

Moderator—E. M. Turner, Wright-Patterson ADC

**DP58-570 Utility of and Techniques Applicable to Adaptive Flight Control Systems.** *Raymond Roth*, Wright-Patterson ADC

**DP* The Impact of the Spiral Antenna and Its Derivatives on the Design of Antennas and the Weapon System.** *E. M. Turner*, Wright-Patterson ADC

**DP* Perarylated Silanes–The Solution to the Problem of Radiation.** *Leonard Spialter*, Wright-Patterson ADC

**DP58-571 A New Approach to Electronic Equipment Design and Packaging.** *Henry Wambolt*, Wright-Patterson ADC

### 2:00 p.m. Management—Franklin Room

Moderator—J. E. Walters, George Washington University

**DP58-595 The Management of Research and Development.** *Hathaway Watson*, Booz, Allen & Hamilton

**DP* Financing Rural Electrification System –A Study in Management.** *J. E. O'Brien, R. D. Partridge, R. H. Robinson*, Rural Electrification Administration

**DP58-572 Motivation and Human Factors in Engineering Leadership.** *L. A. Kilgore*, Westinghouse Electric Corportaion

## Wednesday, April 30

### 9:00 a.m. Electronics—Burgundy East Room

Moderator—F. B. Gunter, Westinghouse Electric Corporation

"N-ary Digital Systems and Error Correcting"

**DP* Improved Methods of Automatic Errors Correction for Teletypewriter and other Binary Signals.** *A. H. Ballard*, Melpar, Inc.

**DP* Comparison of Modulation Systems for Digital Transmission.** *R. Filipowsky*, Westinghouse Electric Corporation

**DP* Quarternary Data Transmission System with Swinging Waveforms.** *R. Filipowsky, E. Scherer*, Westinghouse Electric Corporation

**DP* Coding Systems.** *F. A. Foss*, International Business Machines Corporation

### 9:00 a.m. Power Generation and System Engineering—Burgundy West Room

Moderator—J. J. A. Jessel, Federal Power Commission

**DP* Role of the Corps of Engineers, United States Army in the Field of Hydroelectric Power.** *R. M. Bush*, Corps of Engineers

**DP58-573 Water Quality Problems in Hydroelectric Reservoirs.** *B. J. Peters, Jr.*, Virginia Electric & Power Co.

**DP58-582 Rural Generation and Transmission Systems.** *M. A. Chase*, Rural Electrification Administration

**DP* The Navy's Mobile Power Reserve.** *J. W. Bishop*, United States Navy Department

**DP* The Bureau of Reclamation's Contribution to Electric Power Generation in the United States.** *D. S. Campbell*, Department of Interior

### 9:00 a.m. Chemical and Electrothermal—Madison Room

Moderator—E. L. Brancato, Naval Research Laboratory

**DP* Objectives and Progress of the AIEE Insulation Evaluation Program.** *P. L. Alger*, General Electric Company

**DP* Progress Report on Proposed Test Code for Evaluation of Systems of Insulating Materials for Specialty Transformers.** *L. W. Kirkwood*, Bell Telephone Laboratories

**DP* Progress in the Evaluation of Random Windings and Field Coils in Accordance with AIEE No. 510.** *W. P. Penn*, General Electric Company

**58-574 Development of Standards for Insulation Systems and Insulating Materials.** *M. L. Schmidt*, General Electric Company

### 9:00 a.m. Electricity in Medicine—Franklin Room

Moderator—Ralph Sturm, Bendix Aviation Corporation

**DP* Recent Advances of Cineradiography in Medicine.** *Edward Greaves*, Westinghouse Electric Corporation

**DP* Control System of Dual Isotope Scanner for Detecting Brain Tumors.** *G. I. Johnson*, National Institutes of Health

**DP* Telemetering of Physiological Data from High Altitudes.** *N. L. Barr*, Bureau of Medicine, United States Navy Department

**DP* A Brief History of Point Polarized Electrode Systems.** *Dr. Irvin Levin*, Walter Reed Hospital

### 9:00 a.m. Management—Caribar Room

Moderator—J. E. Walters, George Washington University

**DP* Programming and Control Research and Development Activities.** *C. F. Fridrich*, Diamond Ordnance Fuze Laboratories

**DP* Management of Research Laboratories.** *T. M. Linville*, General Electric Company

**DP* Simulation Studies—A New Area for Computer Application.** *D. N. Chorafas*, Catholic University

### 2:00 p.m. Electronics—Burgundy East Room

Moderator—F. B. Gunter, Westinghouse Electric Corporation

"Multiplex Equipment and Methods"

**DP* Transistors and Magnetic Cores Provide Memory Circuits for Time Division Multiplex System.** *J. C. Myrick, L. W. Mader*, Rixon Electronics, Inc.

**DP* A Time Compressed Single Sideband System.** *M. I. Jacob, J. Mattern*, Westinghouse Electric Corporation

**DP* Time Division Multiplex System.** *S. Wald*, Radio Corporation of America

**DP58-575 Operations Research in Communications.** *L. S. Schwartz, B. Harris, A. Hauptschein*, New York University College of Engineering

### 2:00 p.m. Power Generation and System Engineering—Burgundy West Room

Moderator—C. S. Randall, Potomac Electric Power Company

**DP58-576 The Electrical Features of the Eddystone Station.** *E. B. Shaw, F. W. Myers*, Philadelphia Electric Company

**DP* A Look into the Future.** *R. C. R. Schulze*, Atlantic City Electric Company

**DP* Initial 110-Kv Cable Installation in Baltimore.** *C. S. Fiske, J. W. Gore, Jr., G. V. Bresnick, Jr.*, Baltimore Gas & Electric Company

**DP58-597 Application of Carrier to a Pipe Type Cable System.** *D. F. Burnside*, Westinghouse Electric Corporation; *W. W. Valentine*, Potomac Electric Power Company

### 2:00 p.m. Chemical and Electrothermal—Madison Room

Moderator—P. L. Alger, General Electric Company

**DP* Progress in the Evaluation of Form-Wound Coil Insulation Systems.** *G. L. Moses*, Westinghouse Electric Corporation

**DP* Insulation Applied to Shipboard Electrical Equipment.** *H. P. Walker*, Bureau of Ships, United States Navy Department

**DP* The Selection of Electrical Equipment for Constant Elapsed Life.** *A. F. Lunkens*, General Electric Company

**DP* The Present State and Anticipated Progress in the Field of Dielectric Materials.** *T. D. Callinan*, International Business Machines Corporation

### 2:00 p.m. Distribution Systems, Construction—Caribar Room

Moderator—R. Siegel, General Electric Company

"Serving Large Buildings and Facilities"

**DP* Lighting and Power Problems Encountered in the Design of the Old Age and Survivors Insurance Building, Baltimore, Md.** *N. S. Weiss*, Whitman, Requardt & Associates

**DP* Department of Agriculture Electric Power Supply for 12,000 Tons of Refrigeration.** *J. D. Brooks*, Karsunky, Weller & Gooch; *R. Siegel*, General Electric Company

**DP58-577 Electrical Distribution—Government Printing Office.** *C. T. Adams, R. Bradley, VI*, Henry Adams, Inc.

**DP* Problems in Providing Service to Large Buildings.** *O. R. Hamilton*, Potomac Electric Power Company

**DP58-578 Naval Shore Establishment—Electric Power Systems.** *C. D. Friday*, Bureau of Yards & Docks

### 2:00 p.m. Safety—Franklin Room

Moderator—J. W. Gore, Bethlehem Steel Company

**DP58-579 Electrical Safety in Hospital Operating Rooms.** *N. L. Griffin*, Public Health

**DP58-580 Some Safety Aspects of Electrical Installations on Merchant Vessels.** *J. B. Feder*, U. S. Coast Guard

**DP* Safety in Electrical Codes and Standards.** *R. Lloyd, J. A. Dickinson*, National Bureau of Standards

**DP58-581 From Fishing Rod to "Hotstick."** *E. Dunbar*, Potomac Electric Power Company

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# Great Lakes District Meeting at Kellogg Center on Michigan State Campus

THE 1958 Great Lakes District Meeting of the AIEE will be held May 5-7 at the Kellogg Center for Continuing Education on the Michigan State University Campus, East Lansing, Mich. All meetings, luncheons, and dinners will be held in the Kellogg Center which is a modern, well-planned conference center complete with living accommodations.

The excellent, varied, technical program which has been arranged includes several papers by authors who have not written papers before. This should provide new and interesting ideas and information.

The ladies will find this meeting interesting and especially pleasant. Michigan State University Campus in May will be an experience long remembered.

### Registration

Registration will take place from 4 to 6 p.m. at the Kellogg Center Conference Desk on Sunday and will continue throughout the meeting starting at 8 a.m. each day. Members are asked to return the advance registration card received in the mail indicating the activities in which they plan to participate to insure getting tickets. This will enable the committee to prepare an advance packet containing tickets to all the events a member plans to attend. All fees will be collected at the registration desk. Do not enclose remittances with the advance registration. AIEE registration fee is $3 for members and $5 for nonmembers. There is no registration fee for student members or families of members.

### Living Accommodations

Headquarters for the meeting will be the Kellogg Center for Continuing Education located at the corner of Harrison Road and Michigan Avenue (M-43) on campus. There is ample parking space in the Kellogg Center lot and directly across the street from the Kellogg Center.

The Kellogg Center has 125 double rooms available for Sunday evening and 140 double rooms for Monday and Tuesday evenings. The rate is $4.25 for a twin bed room per person per night. In order to accommodate the maximum number of conference guests, it may be necessary for a member to share a twin bed room with another member of the conference group. If a member does not share a room, the single rate of $7.50 per night will apply. Send room requests to: AIEE Great Lakes District Meeting, Kellogg Center for Continuing Education, Michigan State University, East Lansing, Mich. Indicate preference to share a room or have a private room and advise arrival and departure times. Reservations will be confirmed by the Kellogg Center.

Those who cannot be accommodated at the Kellogg Center will be referred to a hotel in Lansing by the committee. If you have a hotel preference, indicate this preference. The hotel will confirm the reservation. Hotels available (located in Lansing) are:

| | |
|---|---|
| **Hotel Olds** | $5.00 and up for single<br>$7.50 and up for double<br>$9.00 and up for twin |
| **Hotel Porter** | $4.25 to $6 for single<br>$8 and $9 for double |
| **Hotel Roosevelt** | $4.50 and up for single<br>$7.00 for double |

For those who prefer motels the following may be contacted directly for reservations: Chad's Manor Motel, 2½ miles east of East Lansing on U.S. 16; Winslow's Family Motel, 5 miles east of East Lansing on U.S. 16; Motel Topper, 1 mile east of East Lansing on U.S. 16.

*Courtesy Michigan State University*

**KELLOGG CENTER on the Michigan State University Campus, East Lansing, Mich., will be headquarters for the AIEE Great Lakes District Meeting, to be held May 5-7, 1958.**

### Luncheons and Dinners

The luncheon and dinner activities are listed in the program. All meals will be served at the Kellogg Center which is noted for its fine cuisine at very reasonable prices. The luncheons on Monday and Tuesday are $2.00 each. The Monday evening dinner is $3.65 each. The Tuesday banquet is $4.25. Tickets are available at the registration desk and advance registration will be greatly appreciated.

### Student Program

The student program will consist of the District No. 5 Student Branch Paper Competition which will be held on Monday from 8:45 a.m. to 4:00 p.m. Student accommodations will be at Emmons Hall and the room rate will be $3.00 per person for the first night and $2.00 per person the second night or $5.00 for both nights. Reservations should be addressed to the Kellogg Center indicating student accommodations are desired.

The awarding of the student paper competition prizes will be a feature of the Tuesday luncheon.

Students are cordially invited to attend all luncheons and dinners.

### Ladies Activities

The Ladies Activities Committee has planned a full, interesting, and different, yet relaxing and pleasant program for the ladies.

Each morning will begin with a coffee hour from 9 to 10 a.m. at the Kellogg Center. On Monday morning at 10 a.m. there will be a special tour of the campus by bus. This tour will feature items of special interest to the ladies. The bus will deliver the ladies to the Student Union for lunch and a short talk and then return to the Kellogg Center. Price including tour and lunch is $2.50.

The afternoon will be free for strolling about the beautiful campus and shopping in the nearby campus shops. Dinner will be with the men at the Kellogg Center.

Tuesday morning after coffee hour is free time with individual trips to be arranged. Luncheon and bridge at the Walnut Hills Country Club is arranged for the afternoon. Busses will leave from the Kellogg Center at 11:30 a.m. Price of ticket including lunch, bridge, and transportation is $3.75.

Dinner and program on Tuesday evening will be with the men.

### Inspection Trips

The committee advises advance registration for all inspection trips to assure availability of transportation.

There will be campus tours leaving from the Kellogg Center as follows: Monday, 9:30 a.m.; Monday, 10:00 a.m. (Ladies only, includes lunch); Tuesday, 9:30 a.m.; Tuesday, 10:00 a.m. (Students). Cost of campus tours is 35¢.

*Television Station, WJIM* (Monday, 1:40 p.m.) Busses will leave Kellogg Cen-

**CONTROL ROOM of Station WJIM-TV which will be toured during one of the inspection trips planned for the AIEE Great Lakes District Meeting, May 5-7, 1958, East Lansing, Mich.**

ter at 1:40 p.m. for a tour of television station WJIM-TV located in their new Country House. This is a modern station using the latest high power televising techniques. The tour will last approximately 1½ hours. Bus cost is 75¢.

*Oldsmobile Division of General Motors* (Tuesday, 9:00 a.m.) Busses will leave Kellogg Center at 9:00 a.m. for an inspection trip to the Oldsmobile Division of General Motors in Lansing. The trip will include a visit to the "Rocket" engine line, the motor parts plant, pressed metal plant, and final car assembly. Trip requires about 90 minutes. No cameras permitted. Bus cost is $1.

### Committee Members

Members of the Great Lakes District Meeting Committee are: general chairman, J. A. Strelzoff; technical program, M. Westrate; ladies activities, Mrs. J. D. Ryder; inspection trips, M. B. Rann; finance, A. W. Rauth; dinners, K. Norris; speakers, T. W. Culpepper; registration, B. K. Osborn; transportation, H. G. Hedges; hotel, W. C. Peterson; student activities, M. A. Melehy; contact, W. R. Carlyon; publicity, J. J. Fredrickson.

### Mailed Announcement

A mailed announcement of this meeting will be sent to members in District No. 5. If a copy is desired by members in other Districts, please write to E. C. Day Assistant Secretary for Technical Papers and Programs, TOD, American Institute of Electrical Engineers, 33 W. 39th St., New York 18, N. Y.

The tentative technical program for the District Meeting follows.

## Monday, May 5

### 8:00 a.m. Registration—Kellogg Center Conference Desk

### 9:00 a.m. Power Transmission and Distribution—Lincoln Room A

M. W. Balfour, Consumers Power Company, presiding

**DP58-508 Short-Circuit Tests on Bundled Conductors.** *A. L. Malmstrom, L. G. Gifford, J. O. Smith,* The Detroit Edison Company

**58-509 Characteristics of Twin Conductor Arrangements.** *E.T.B. Gross,* Illinois Institute of Technology; *L. R. Stensland,* Sargent & Lundy

**DP58-510 The 46-Kv Submarine Cable Crossing in the Straits of Mackinac.** *J. G. Stelzer, R. W. Schwaderer,* Consumers Power Company; *T. F. Loraditch,* Okonite Company

DP* **Application of 46-Kv Reclosers.** *C. R. French,* Consumers Power Company

### 9:00 a.m. Communications I—Lincoln Room B

J. C. Leffel, Michigan Bell Telephone Company, presiding

DP* **A Communication System for the A.A.O.C.** *H. I. Ingram,* Illinois Bell Telephone Company

DP* **General Aspects of Railroad Communications.** *L. J. Ritter,* New York Central Railroad

DP* **Telephone Special Services in Metropolitan Area.** *E. C. Carlson,* Illinois Bell Telephone Company

DP* **General Telephone Company Application of Automatic Timing and Ticketing (SATT) for Toll Calls.** *B. F. Robinson,* General Telephone Company

### 9:00 a.m. Industry—Room 103

B. J. Drummond, Chrysler Corporation, presiding

DP* **Static and Proximity Control in the Automotive Industry.** *G. Paris, K. Sheffer,* Ford Motor Company

DP* **Induction and Dielectric Heating.** *C. F. Hauri,* General Motors Corporation

DP* **Electrical Circuitry of Noise and Vibration Dynamometer.** *M. Patterson,* Chrysler Corporation; *R. E. Conner,* Westinghouse Electric Corporation

**DP58-511 Protecting Tomorrow's Circuits Today.** *N. Shackman,* BullDog Electric Products Corporation

### 12:00 Noon Luncheon—Big Ten Room

H. Hess, Wayne State University, presiding

DP* **A Scientific Tour of Soviet Russia.** *W. C. Dunlap, Jr.,* Bendix Research Laboratories.

### 2:00 p.m. Power Generation and Systems—Lincoln Room A

A. P. Fugill, The Detroit Edison Company, presiding

**58-512 Bay Shore Generating Station—An Analysis of Specific Electrical Features.** *R. May, C. M. Gardam,* Toledo Edison Company

DP* **Powerhouse Auxiliary Systems for Nuclear and Supercritical Pressure Plants.** *E. F. Kratz,* Westinghouse Electric Corporation

DP* **Determination of the Optimum Transmission Voltage, 345 Kv vs 138 Kv.** *R. D. Camburn, R. L. Stafford,* Commonwealth Associates Inc.

DP* **Consumers Power Probes 345 Kv.** *H. F. Small, J. M. Brager,* Consumers Power Company

**58-513 Improved Method of Interconnecting Transmission Loss Formulas.** *A. F. Glimn, L. K. Kirchmayer,* General Electric Company; *J. J. Skiles,* University of Wisconsin

### 2:00 p.m. Communications II—Room 103

J. C. Leffel, Michigan Bell Telephone Company, presiding

DP* **Florida-Cuba Over-the-Horizon System.** *M. C. Gehring,* American Telephone and Telegraph Company

DP* **Public Air-Ground Telephone Service Trial.** *L. M. Augustus,* Michigan Bell Telephone Company

DP* **Operation of ON over K Carrier.** *J. W. Korte,* Northwestern Bell Telephone Company

**DP58-514 Overmodulation of a Carrier by Sine Wave and Gaussian Noise.** *D. R. Rothschild,* University of Michigan

### 2:00 p.m. Education—Lincoln Room B

A. R. Hellwarth, The Detroit Edison Company, presiding

DP* **Can an Electric Power Company Afford a College-Trained Engineer?** *J. H. Lampe,* North Carolina State College

DP* **The Electric Power Industry's Stake in Engineering Education.** *J. S. Johnson,* Wayne State University

DP* **What Is the Engineer's Horizon in the Electric Power Business?** *G. A. Porter,* The Detroit Edison Company

### 6:00 p.m. Dinner—Big Ten Room

### 7:30 p.m. General Session—Auditorium

J. H. Foote, vice-president, AIEE Great Lakes District, presiding

DP* **Missiles and Manpower.** *J. D. Ryder,* Michigan State University

## Tuesday, May 6

### 8:00 a.m. Registration—Kellogg Center Conference Desk

### 9:00 a.m. Electrochemical—Lincoln Room A

F. M. Baxandall, Dow Chemical Company, presiding

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* District Papers will not be printed by the Institute; however, they may be available at the meeting at the discretion of the author.

**DP58-515 Sources of D-C Power for Electrochemical Application.** *W. A. Stelzer*, Dow Chemical Company

**DP* D-C Current Regulation of Rectifiers for Chlorine Plants.** *C. Rettig, J. P. Smith*, General Electric Company; *J. S. Marr*, Wyandotte Chemicals Corporation

**58-516 Design Features of Large Semiconductor Rectifiers.** *I. K. Dortort*, I-T-E Circuit Breaker Company

### 9:00 a.m. Substations and Equipment—Lincoln Room B

E. Zavitz, The Detroit Edison Company, presiding

**DP* Modular Structural Member Design for Substations.** *R. C. Adler, J. T. Henderson, J. M. Waters*, Commonwealth Associates Inc.

**DP* Placement of Lightning Arresters in Substations.** *D. Burk, A. H. Knable*, Allis-Chalmers Manufacturing Company

**DP58-517 A Steel Transformer Enclosure for Noise Attenuation.** *R. D. Hillier, B. H. Schneider*, The Detroit Edison Company

**DP-58-518 Double Bus Distribution Substations.** *J. G. Spath, J. B. Oliver*, The Detroit Edison Company

### 9:00 a.m. Electronics—Room 103

H. S. Mika, Ford Motor Company, presiding

**DP58-519 Increasing the Effective Dynamic Range of a Radar.** *K. M. Siegel*, University of Michigan

**DP58-520 Linear Rate Generator.** *L. F. Stauder*, University of Notre Dame

**DP58-521 Analysis of an Oscillating Detector.** *H. Burr, A. Naylor*, University of Michigan

**DP58-522 Panoramic Receiver Simulator.** *B. Haseltine*, University of Michigan

**DP58-523 Power and Distortion in Transistor Amplifiers.** *J. D. Horgan*, Marquette University

### 12:00 Noon Luncheon—Big Ten Room

L. W. Von Tersh, Michigan State University, presiding

Address: I. Travis, vice-president, Burroughs Corp.

Awarding of Student Paper Prizes

### 2:00 p.m. Industrial Application—Lincoln Room A

F. Von Voigtlander, Cummins & Barnard, Inc., presiding

**DP* Polyphase Motor Selection for Duty Cycle Applications.** *G. C. Morris*, Howell Electric Motors Company

**DP* Qualitative Description of Inertial Guidance Principles.** *W. H. Holl, B. P. Miller, C. F. Vondra*, General Motors Corporation

**DP* Design Considerations for Surface Measuring Equipment.** *K. R. Morris*, Micrometrical Development Corporation

**DP58-524 Overvoltage Protection and Maintenance Testing of A-C Rotating Machines.** *H. R. Armstrong, J. E. Mulavey*, The Detroit Edison Company

### 2:00 p.m. Basic Sciences I—Lincoln Room B

J. J. Carey, University of Michigan, presiding

**DP58-525 A 4-Dimensional Curve Tracer.** *W. F. Clark*, University of Detroit

**DP58-526 A Simplified Solution of Coupled Circuits.** *T. Janisz, A. A. Toppeto*, University of Detroit

**DP58-527 Linear Graph Theory (Topology) in Engineering.** *H. E. Koenig, M. B. Reed*, Michigan State University

**DP58-528 The Electrical Production of a Mathematical Ellipse.** *E. B. Kurtz*, University of Iowa

**DP58-529 Electromechanical Impedance, Analogs, and Duality.** *W. B. Swift*, University of Wisconsin

### 2:00 p.m.—Automotive Auxiliaries—Room 103

C. R. Jacobsen, Commonwealth Associates Inc., presiding

**DP* Application of Practical Optics for Auto Lighting.** *P. J. Blinkild*, Chrysler Corporation

**DP58-530 Design Considerations for an Engine-Generator Unit for Public Utility Line Construction Trucks.** *H. J. Wurth*, Commonwealth Associates Inc.

**DP* A System for the Production of a Pulsating X-ray Beam.** *A. J. Gioia*, General Motors Corporation

### 6:00 p.m. Banquet—Big Ten Room

J. A. Strelzoff, Michigan State University, presiding

Address: J. H. Campbell, senior vice-president, Consumers Power Company

State Singers, Michigan State University, Richard Klausli, director

## Wednesday, May 7

### 9:00 a.m. Nuclear Developments—Lincoln Room A

J. F. Anderson, Power Reactor Development Company, presiding

**DP* Auxiliary Power Design Considerations for a Nuclear Power Plant.** *S. Tjepkema*, Commonwealth Associates Inc.

**DP* Nuclear Instrumentation for Reactors.** *C. W. Ricker, W. Kerr*, University of Michigan

**DP* Instrumentation Adequate To Insure Health and Safety around a Power Reactor.** *G. H. Whipple*, University of Michigan

**DP* Nuclear Plant Control System Study.** *R. A. Thomas*, Atomic Power Development Associates, *S. Irwin*, Holley Carburetor Company

**DP58-531 Electrical Engineering Aspects of the Enrico Fermi Atomic Power Plant.** *R. H. Logue*, Power Reactor Development Company

**DP* Design of a Reactor Oscillator for the Ford Nuclear Reactor.** *J. Stone, W. Kerr*, University of Michigan

### 9:00 a.m. Computers, Analog and Digital—Lincoln Room B

D. C. Harker, Commonwealth Associates Inc., presiding

**DP* Some Digital Techniques Applied to Analog Computation.** *R. Gaskill*, Ford Motor Company

**DP* Power System Demonstration Equipment for Educational Purposes.** *L. F. Stauder*, University of Notre Dame

**DP* The Calculation of the Electric Field Energy of Moving Charged Particles.** *R. J. Reid*, Michigan State University

**DP* Some Operational Problems in Analog Computers.** *M. A. Melehy*, Michigan State University

### 9:00 a.m. Basic Sciences II—Room 103

J. J. Carey, University of Michigan, presiding

**DP58-532 Measurement of the Scattering Matrix with an Intervening Ionosphere.** *H. Brysk*, University of Michigan

**58-533 A Constant-Amplitude Random Function Generator.** *G. A. Hellwarth*, University of Michigan

**DP58-534 Spinning Disc Random Selectors.** *G. A. Roberts*, University of Michigan

**DP58-535 Synthesis of Lossless Networks for Prescribed Transfer Impedances between Several Current Sources and a Single Resistive Load.** *A. B. Macnee*, University of Michigan

# 1958 Winter General Meeting of AIEE Sets Record for Attendance

THE 1958 AIEE Winter General Meeting, held in New York, N. Y., February 2-7, at the Statler and Sheraton-McAlpin Hotels, set records in attendance, and in number and variety of technical sessions and papers presented. Total attendance of members and guests was 5,340, a figure which exceeded the previous high of 5,036 set in 1956. There were aproximately 450 papers read at 110 technical sessions. A noteworthy feature of the meeting was the record number of students present.

The launching of the United States satellite "Explorer" just a few days prior to the meeting heightened public interest in the proceedings which received good press coverage and some editorial comment in the Metropolitan New York press.

#### Social Program

During the Eta Kappa Nu Recognition Award Dinner, held Monday evening, February 3, R. P. Crago of International Business Machines Corporation, Dr. W. R. Beam of Radio Corporation of America, Princeton, N. J., and G. W. Stagg of American Gas and Electric were honored. Mr. Crago received the 1957 Outstanding Young Electrical Engineer Award.

The smoker held on Tuesday evening featured good food, good fellowship, and top quality entertainment and the dinner-dance held in the Grand Ballroom of the Hotel Statler was as successful as always.

Inspection trips of both technical and general interest included the Radio City Music Hall, East River Generating Station of the Consolidated Edison Company, new Ticket Bureau in the Pennsylvania Railroad Station, and Reaction Motors in Denville, N. J.

#### General Session

The general session on Monday afternoon was opened by D. M. Quick, Winter General Meeting chairman. He introduced J. H. Foote, vice-president of the Great Lakes District, who read the prepared remarks of President W. J. Barrett, who was indisposed with the grippe.

President Barrett's address stressed the importance of the Institute in this time of the Sputniks, citing C. F. Kettering who told President Barrett that societies like the Institute "are the most important organizations in the world today."

The growth of membership to 51,000 and the corresponding increase in the number and complexity of Institute services has made it evident to the Board of Directors that major changes in the Institute are required. Some changes have recently been made and others are in process, it was stated. The entire committee structure of the Institute, for example, is now organized into five Departments each of which has been granted full responsibility and commensurate authority within the broad policies of the Board.

Proposed changes in the Institute's accounting and fiscal affairs which are now cumbersome and ineffective will introduce modern accounting methods including the use of business machines. Headquarters staff itself will be examined so that an ideal organization chart can be drawn up, proper salary schedules established to attract and hold competent personnel.

An investigation is being made into the declining rate of growth in membership which is not due to a lack of people interested in the field of electrical engineering. A committee has been appointed, it was stated, that will thoroughly examine the activities and organization of the entire Institute to try to determine just where it has failed to meet the needs of potential candidates.

Also stressed was the importance of technical groups within the local sections of the Institute so that the large number of members who cannot attend General Meetings and Special Technical Conferences will have an opportunity for technical meetings in their particular fields of interest.

Progress on the United Engineering Center is being made. President Barrett in his remarks, expressed the hope "to invite all of you to visit the new United Engineering Center during our Winter General Meeting in 1961."

B. G. A. Skrotzki, of the Institute's Prize Awards Committee presented prize awards for the best technical papers given at Institute meetings during the period of August 1, 1956, to July 31, 1957. Papers selected for first and second prizes in five of the Institute's six Technical Divisions were as follows:

*Communications Division.* First prize: "The Work of the International Telecommunication Union in the Field of Telephony," by W. E. Bloecker, American Telephone & Telegraph Co. (AT&T), New York, N.Y., and G. A. Caldwell, Bell Telephone Company of Canada.

*Industry Division.* First prize: "A Quick Method for Estimating Closed-Loop Poles of Control Systems," by Kan Chen, Westinghouse Electric Corporation, East Pittsburgh, Pa. Second Prize: "A Two-Dimensional Feedback Control System," by P. Sarachik, and J. R. Ragazzini, Columbia University, New York, N.Y.

*Instrumentation Division.* First Prize: "An Electrometer as a Versatile Corona Detector," by J. G. Anderson and J. S. Kresge, General Electric Company (GE), Pittsfield, Mass. Second Prize: "The Response of Resistance Voltage Dividers to Steep-Front Impulse Waves," by A. F. Rohlfs, J. S. Kresge, and F. A. Fisher, GE, Pittsfield, Mass.

*Power Division.* First prize: "Calculations of Windage Noise Level in Large Induction Motors," by M. E. Talaat, Elliott Company, Ridgeway, Pa. Second prize: "Some Aspects of Tie-Line Bias Control on Interconnected Power Systems," by Nathan Cohn, Leeds & Northrup, Philadelphia, Pa. Third prize: "Relation between Corona and Radio Influence on Transmission Lines, Laboratory Studies, Part I—Point and Conductor Corona," by T. W. Liao, W. A. Keen, Jr., and D. R. Powell, GE, Pittsfield, Mass.

*Science and Electronics Division:* First prize: "Rectilinearity of Electron Beam Focusing Fields from Transverse Component Determinations," by P. P. Cioffi, Bell Telephone Laboratories, Murray Hill, N. J. Second Prize: "Core-Reset Functions in Magnetic Amplifier Analysis—Part I," by G. C. Feth, Carnegie Institute of Technology, Pittsburgh, Pa.

*Student Division.* First Prize: "A Method of Designing Transistor Switching Circuits," by J. D. Burroughs. Second Prize: "A Transistorized Voltage Regulator," by N. A. Shyne.

The report of the Nominating Committee was given by M. D. Hooven, chairman of the Nominating Committee. Nominees are listed on page 354 of this issue.

A highlight of the general session was the presentation of the Thomas A. Edison Medal to J. K. Hodnette, executive vice-president, Westinghouse. The presentation was reported in *Electrical Engineering*, March 1958, pages 214-217.

The keynote address, "Education and the Science Frontiers," by T. J. Watson, Jr., president of the International Business Machines Corporation (IBM), appears on pp. 323-25 of this issue.

### Technical Sessions

*Computers.* The AIEE Land Transportation Committee sponsored a session devoted to the subject of computers in the field of railroad transportation. In the first paper, J. E. Hogan, Pennsylvania Railroad Company, described the calculation of train performance and locomotive tonnage ratings by means of a digital computer.

D. R. MacLeod of GE discussed the uses of digital computers and differential analyzers in transportation equipment design. They make possible the rapid calculation of schedule speeds, power consumption, and propulsion equipment stability, as demanded by the changes in traffic requirements on railroads and rapid transit systems.

*Wire Communications.* J. N. Petrie of the Automatic Electric Company discussed dial switching of toll circuits in independent telephone company areas, with the emphasis on transmission requirements and considerations.

*Courtesy Ross Photos*

**IN GROUP (above) are some of the winners of awards for best technical papers given at Institute meetings during the period August 1, 1956, to July 31, 1957. Awards were presented during the general session of the Winter General Meeting. At right: Nathan Cohn (*right*) winner of second prize for a technical paper in the Power Division, is shown chatting with his employer, M. I. Stein (*left*), president of Leeds and Northrup; and D. M. Quick (center), Public Service Gas and Electric Company, who was general chairman of the Winter General Meeting. Mr. Cohn is manager of the Market Development Division at Leeds and Northrup.**

Courtesy Ross Photos

**J. K. HODNETTE (second from left), executive vice-president, Westinghouse Electric Corporation, Pittsburgh, Pa., receives the AIEE Edison Medal from J. H. Foote (second from right), vice-president, AIEE District No. 5, during the opening General Session of the Winter General Meeting. W. H. Sammis (left) gave the career of the medalist, and E. B. Robertson (right) gave the history of the medal.**

G. H. Speake of the Southern Bell Telephone & Telegraph Company presented a paper on return losses of loaded trunk cables. He briefly reviewed the meaning of return loss, and discussed some of the practical factors encountered in analyzing and improving these losses.

Also presented at this session were "Impedance and Return Loss Performance of Telephone Plant in Metropolitan Areas" by L. B. Bogan and "Nation-Wide Switching of Intertoll Trunks—Transmission Considerations" by O. F. Wallman, both of the American Telephone & Telegraph Company (*Electrical Engineering*, March 1958, pp. 225 and 237 respectively).

*Switchgear.* A Thursday morning session on switchgear opened with a paper by R. H. Albright of the I-T-E Circuit Breaker Company, describing a 138-kv metal-enclosed isolated-phase bus and switching structure. A digest of this paper appears on page 303 of this issue.

A 46-kv low-capacity circuit breaker and a 46-kv automatic circuit recloser were described in two papers, by R. N. Yeckley and R. H. Cunningham of Westinghouse, and E. J. Field of I-T-E, respectively.

Another paper presented at this session outlined service experience and staged field tests on a 115-kv 1,000-mva gas-filled power circuit breaker used on the transmission system of the Gulf Power Company in Florida, and designed by Westinghouse.

*Communication Theory.* Among several interesting papers presented at a Wednesday afternoon session sponsored by the AIEE Communication Theory Committee was "Entering the Machine Domain" by S. L. Seaton of Hampton, Va. (See pp. 289-92 of this issue of *Electrical Engineering*.)

A paper by R. Filipowsky of Westinghouse was concerned with recent progress in the application of information theory to digital transmission systems. The author stressed four specific points which are likely to be overlooked by practical engineers: (1) the difference in the detection problem for radar and communications; (2) the lack of an adequate definition for a digital communication system; (3) the importance of using larger signal alphabets; and (4) the importance of defining directly bandpass waveforms in place of low-pass waveforms plus modulating systems.

*Power Generation and System Engineering.* A. L. Miller of the Cleveland Electric Illuminating Company discussed some of the details of outage probability calculations, using illustrative examples. By means of methods described, loss-of-load risks can be rapidly evaluated for a wide variety of specific projects. Valid comparisons between various proposals may then be made, to assist in system planning.

A paper by Herman Halperin and H. A. Adler of Commonwealth Edison Company describes reserve generating capability studies. These studies have been used for two main purposes: (1) to furnish management with evaluations of reserves corresponding to varying degrees of reliability for use in determining required additions to generating capacity; and (2) to provide a basis for comparison of alternative plans for system development.

*Substations.* P. R. Harris of the Southwestern Gas and Electric Company, Shreveport, La., discussed the advantages of conventional substation construction in the territory served by his company. Among these advantages are the flexibility in design to meet various requirements of application, the economies resulting from favorable distribution voltages, availability of suitable substation sites, favorable relations with neighboring property owners, and an economic design. A preference for conventional substations was also expressed in a paper by A. H. Thiermann of the Virginia Electric and Power Company.

Two papers were also presented giving operating experience with and advantages of unit substations. The first of these, "Single Circuit Unit Substations," was presented by J. F. Jones of the Baltimore Gas & Electric Company. The second, by D. C. Switzer of the Hartford Electric Light Co. and H. B. Wortman of Westinghouse, covered installations in the Hartford, Conn., area.

*Electron Tube Developments.* Several interesting new electronic tubes were described in a session sponsored by the AIEE Electronics Committee. C. V. Weden of Machlett Laboratories, Inc., described a high-power high-permeance low-mu triode. A paper by J. M. Lafferty of the GE Research Laboratory covered a development in the field of voltage regulator and reference tubes for critical environments. The tubes discussed have envelopes of forsterite ceramic and titanium metal, and feature reliable and reproducible characteristics, ruggedness, and ability to operate at high ambient temperatures (500 C).

*Production and Application of Light.* In the session on the production and application of light, presided over by D. W. Rowten and R. D. Churchill, a progress report of 1957 on sources and equipment was made.

A GE representative demonstrated some of the advances made by his company. The lumens per watt efficiency has been greatly increased by use of the coiled-coil filament in lamps from 300 to 1,000 watts; also the vertical filament prevents the bulb's blackening. Built-in reflectors and beam distribution, either in flood or spot lights, control the light distribution better than was formerly possible.

In the household, the size of the bulbs has been reduced for the same wattage lamps; also the inside silica coating giving color and reduction of glare, means greater eye comfort.

New Christmas lamps and photoflood lamps were demonstrated. New infrared lamps having 100 watts per inch of length were shown in sizes from 500 through 5,000 watts.

A Westinghouse representative followed with the recent progress made in mercury lamps, saying that since 1950 these lamps have doubled in dollar value. Sizes are now available in 175- and 250-watt lamps as well as the basic one of 400 watts. For industrial uses, these mercury lamps come in 700-, 1,000-, and 1,500-watt sizes. The fluorescent mercury lamps are now color corrected with the red portion of the spectrum replaced and there is an improvement in the yellow-green area. The output and life of these lamps have been improved, giving up to 7,000 hours or longer.

Mr. Churchill of GE spoke about the fluorescent lamp and its continued improvement in performance. New rapid starters, a low-loss cathode and a silicone outside coating, the ability to dim and flash the lamps, reduction in ballast noise—all contributed to fluorescent-lamp improvement.

A white pigment reflector covering 220 degrees of the tube results in 75% of the light being directed downward, which means more foot-candles available.

Other speakers told about developments in lighting fixtures, translucent plastic ceilings, new street lights, higher frequencies of 400 cycles for fluorescent lamps, and electroluminescent lighting.

*Joint Session.* "Thinking Machines of the Future" was a session sponsored by the Computing Devices, Communication Theory, Research, and Data Communication Committees. E. L. Harder, who presided, outlined the session's theme by posing the questions, "Where is information contained? How is it retrieved?"

Prof. J. B. Wiesner, Massachusetts Institute of Technology (MIT), spoke about information processes, such as language, numbers, etc., and then about the channels of information, seeing, talking, etc. There is a similarity between the human brain and computers in that there is a transference of the symbols that exchange information.

"The Future Matching of Man and Machine" was the subject of the talk by Simon Ramo of the Ramo-Wooldridge Corp. Man uses a very small part of his brain daily and thought is really a choice between one of two, one of three, etc. Assume a high intellectual choice, for instance, the field of education. Try to separate what part of a teacher's function could be taught by a machine. A teacher observes and teaches what she observes. A machine can be set up to give examinations with "true or false" buttons for the student to select, but someone must teach. There are two controlling factors in matching man and machine: systems engineering and the economic factors.

C. R. De Carlo, IBM, gave the manufacturer's point of view on computers. He reviewed the progress of computers and then described some of the multiunit machines of the present and future.

*Refining and Chemical Processes.* The problem of static control in the petroleum industry was the subject of J. C. Howard's paper, "Static Electricity in the Petroleum Industry." Many fires of unknown origin have been attributed to static electricity with some justification, the author noted. Conclusions after careful investigations show that certain operations can produce static sparks of incendiary proportions. Because ignition by static sparks is practically never witnessed, and no evidence remains, the problem requires a study of fire reports to determine if conditions were favorable for the generation of static electricity.

Protection has improved in recent years through increased knowledge of the problem, Mr. Howard said, and some protective measures originally thought to be necessary have practically disappeared such as the drag chain formerly attached to oil trucks. However, the industry is confronted with some unsolved static problems which are not new but which have assumed serious proportions because of the increased handling of jet fuels that possess a much broader explosive range than that of gasoline. These problems are detailed in the paper.

Other papers were "Cypak and Its Application in the Petroleum and Chemical Industries," by P. G. Hanna and C. R. Olson, Westinghouse; and "Electric Safety in the Chemical Industry," by E. J. Meyers, E. I. du Pont de Nemours & Co. (Inc.)

*Magnetic Amplifiers.* The Theory Subcommittee of the Magnetic Amplifier Committee sponsored a session which was unusual for AIEE General Meetings. The purpose was to discuss informally the theory and design of magnetic amplifiers. The questions were posed and answered by the audience, and subjects such as feedback in magnetic amplifiers, effects of leakage reactance, 3-phase and high-temperature amplifiers, were discussed candidly and with considerable benefit to the audience. This meeting started at 7:30 p.m. and it was attended by about 90 people. The meeting was officially adjourned at 9:30 p.m. However, a rump session of about 50 people remained, and continued discussions until 10:30 p.m. The session leader was the chairman of the Theory Subcommittee, H. F. Storm.

At another magnetic amplifiers session, a review of the present status of terms and definitions in the rapidly expanding magnetic amplifier field was presented by the AIEE Definitions Subcommittee of the AIEE Magnetic Amplifiers Committee in their paper "Proposed Standard Terms and Definitions for Magnetic Amplifiers." A large amount of literature had to be examined to extract those technical terms referred to, described, and defined, chairman D. Feldman said.

The project of preparing a group of preferred terms and definitions in a dynamic technical field is hampered to some extent by the dictionary's definition of "term" and "definition." The problem facing the Subcommittee during the last several years has been one of attempting to provide just one term and one definition which would be adequate.

Other papers presented included "Magnetic Amplifier Design (Part II—The Windings)," by R. E. Anderson, GE; and "High Efficiency Push–Pull Magnetic Amplifiers with Transistors as Switched Rectifiers," by A. G. Milnes, Carnegie Institute of Technology.

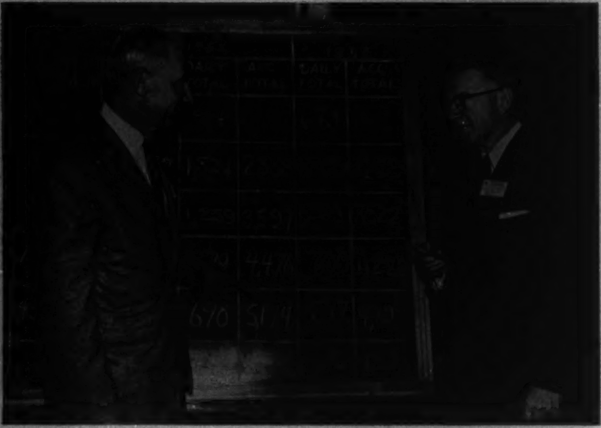
*Television Broadcasting.* A description of "A New Vidicon Camera for Live Pickup," by F. W. Millspaugh and J. H. Roe of Radio Corporation of America (RCA), Camden, N. J. that extends the advantages of the vidicon tube into the field of live pickup applications was described at one of Tuesday's afternoon sessions. It is designed in accordance with broadcast equipment standards and includes many features that will insure the maximum in performance for broadcast or closed-circuit operations where the light level is adequate for vidicon use. The equipment design includes the latest techniques in circuitry and compatability in packaging with other RCA camera chains. Complete chain includes the camera, a 14-inch rack-mounted output amplifier chassis, and a 2-11/16-inch camera control panel. Another paper presented was "The Effect of Local Field Conditions on Television Receiver Design," by E. Freeland, Philco Corporation.

*Radio Communications and Television and Aural Broadcasting.* The first successful use of over-the-horizon tropospheric (6 to 12 miles high) scatter links for television transmission was described in a paper "The Miami–Havana Radio System and Its Integration into the Telephone Networks," by K. P. Stiles, F. G. Hollins, and E. T. Fruhner, AT&T, and W. D. Siddall, Radio Corporation of Cuba.

Starting south from Miami, Fla., the authors reported, two links of *ID-2* microwave equipment are used to connect Miami terminal equipment to the over-the-horizon equipment at a radio station in Florida City at the southern tip of the State. From Florida City to Guanabo, Cuba, the 185 mile jump is made by means of the over-the-horizon equipment. A 14-mile *TD-2* microwave link is used

**DANILO ZUCOLI, 25, of Milan, Italy, (*left*) was the winner of the Volta Fellowship offered to an Italian engineering student to further his education. He is congratulated by L. F. Stone (*center*), vice-president of AIEE District No. 3; and Harold Osborn (*right*), president of the Volta Fellowship Trustees, who introduced Mr. Zucoli at the general session of the Winter General Meeting.**

*Courtesy Ross Photos*



Courtesy Ross Photos

**D. M. QUICK (left), general chairman of the Winter General Meeting, points out registration figures to AIEE President W. J. Barrett (right). This year, total attendance of members and guests was 5,340, a figure which exceeded the previous high set in 1956.**

to transmit the signal to terminal equipment at Havana.

In a companion paper, R. A. Felsenheld, H. Havstad, J. L. Jatlow, D. J. LeVine, and L. Pollack of the Federal Telecommunication Laboratories presented a technical description of over-the-horizon equipment.

*Industrial Control.* "Proximity Switches—Characteristics, Design, and Application," by F. A. Manners and R. C. Mierendorf, Square D Company, was one of the subjects discussed at this Wednesday afternoon session. A more critical look is being taken of the control design problem because of expanding demands of automation with its emphasis on the "functional system" design concept in which the machine and its control are considered as an integral whole. Several large users of machine tools have contributed to the advances in this field, the authors indicated, through surveys which have pointed out the magnitude of the "input" problem. The results indicate that co-ordinating (logic) and output elements such as relays and starters are responsible for only some 10% of system failures and down time. The great majority of the problems are traceable to the input devices and purely mechanical problems.

A companion paper described "An Improved Static Digital Control System," by J. J. McNeill and H. A. Perkins, Jr., of Westinghouse.

*Radiation Effects on Dielectrics.* The effects of ionizing radiation on those qualities of plastics most in demand by manufacturers was the subject of the paper "A Method for the Evaluation of Radiation Damage to the Mechanical Properties of Plastics," by J. H. Kleinpeter of the GE Company. Plastic qualities of electrical resistance, dielectric strength or chemical inertness, hardness, and impact strength were investigated. The author pointed out that the physical tests made and the evaluation methods used are adaptations of procedures developed for the measurement and control of truly elastic materials.

Another interesting paper at this session was "The Radiation Effects Information Center," by H. R. Batchelder, and C. J. Lyons, both of the Battelle Memorial Institute.

*Rotating Machinery.* F. S. Oliver, Doble Engineering Company, discussed the merits of various test methods currently available for testing the electrical insulation of rotating machinery in his paper "Medium Voltage A-C Testing of Rotating Machinery Insulation." He expressed the opinion tests for general maintenance should be almost exclusively a-c medium-voltage measurements of dielectric loss or power factor and radio influence voltage.

A companion paper was the "Separation of Absorption and Leakage Components in High Voltage D-C Insulation Testing," by F. R. Schleif and L. R. Engvall, both of the U. S. Bureau of Reclamation.

*Engineering Education in Foreign Lands.* The USSR will have technological "firsts" other than Sputnik because of her high standard of education and research, P. A. Albetti and G. F. Lincks of GE, reported in their paper "Electrical Engineering Education and Research in the USSR." The authors, who have studied Soviet technology extensively, admitted the picture they presented may not be entirely correct because of contradictions between various sources, language difficulties, and lack of full information. Their survey, however, established that the USSR is instilling an understanding and respect for the scientific approach in all its peoples by early teaching of science; Soviet institutes and universities are graduating 60,000 engineers annually compared with our 25,000 to 30,000; capable students get free or low tuition for higher education; research and educational facilities are excellent.

*Data Communications.* A. E. Ruppel, Bell Telephone Laboratories, presented a paper on "Methods of Evaluating the Transmission Performance of the *A1* Digital Data Signaling System." Before making an analysis on an over-all data system, information must be determined, he said, on the error rate performance of the data generating equipment, the data using equipment, and the interconnecting data transmission system. Many methods have been devised for determining the transmission performance of the high speed *A1* Digital Data Signaling System which transmits data at 1,300 and 1,600 bits per second. Mr. Ruppel discussed these methods and some of the results that have been obtained. Another interesting paper was the "SAGE Data System Considerations," by R. G. Enticknap, Lincoln Laboratories, and E. F. Schuster, Western Electric Company.

# Highlights of the February AIEE Board of Directors Meeting

THE Board of Directors of AIEE met as usual during the Winter General Meeting in New York, N.Y., on February 7, 1958. All members, except two Directors were present. Five nominees for the 1958-59 Board, whose names were announced by the Nominating Committee on February 3, were also present by special invitation. The resignation of E. S. Lammers, Jr., now of Gainesville, Fla., was accepted with regret; and E. C. Starr, Portland, Oreg., one of the nominees, was elected to fill the unexpired term of six months.

### Finances

The Treasurer's report showed a balance in the general fund of $172,143.71 as of December 31, 1957. The Finance Committee presented a detailed comparison of income and expenses, for the first eight months of the fiscal year, with the budget and with the experience of last year. The results were favorable, but the possibility of a decline in income from advertising in the last four months was noted. The Finance Committee presented a plan to streamline disbursement procedures which was adopted by the Board for immediate implementation. The 1958-59 Budget will be organized on Departmental lines. A recommendation from the United Engineering Trustees for an increase of the Library Assessment from 40¢ to 50¢ per member was approved; thus raising AIEE's total annual contribution to the support of the Engineering Societies Library to $30,000. The AIEE Retirement System was revised to bring it into line with modern practice in this field. By-law 20 was amended, as detailed elsewhere in this issue, to require that dues be paid by October 1; and to stop publication mailings after that date. This means that to be in good standing a member's dues must be paid before October 1, and that the October issue of *Electrical Engineering* will be the last one mailed to those who have not paid by October 1.

### Intersociety Affairs

Dr. L. M. Goldsmith, of Philadelphia, Pa., was introduced to the Board as the chairman of the AIEE Member-Giving Campaign for the new United Engineering Center. Dr. Goldsmith announced a goal of $900,000 from AIEE member gifts and explained the plan for solicitation of every member by personal contact. The District and Section organization of the Institute will be employed in this campaign.

A redistribution of responsibility for AIEE representatives on other bodies among the Departments was recommended by the Administration Department and approved by the Board. The addition of the American Institute of Industrial Engineers to the roll of constituent societies of Engineers Joint Council was approved. The support and participation of AIEE in the forthcoming meeting of the Conference of Representatives from Engineering Societies of Western Europe and U.S.A. (EUSEC) was confirmed. The conference will be held in New York, N.Y., April 28-May 2, 1958. The appointment of C. H. Linder to be AIEE representative on the United States Committee Council of the International Electrotechnical Commission was confirmed. Membership of AIEE in the American Automatic Control Council for 1958 was accepted.

### Bylaw Amendments

At the Fall meeting of the Board on October 11, 1957, it was decided that bylaw amendments would normally become effective with the change of administrations on August 1; but that, if an earlier effective date is to apply, special announcement in *Electrical Engineering* would be made. Such announcements appear in this issue on page 347. At this meeting of the Board, the bylaws were amended to produce the following effects: (1) to render practically automatic the advancement of a student member, in good standing, to Associate Member or Affiliate, as qualified; (2) to create a new District, beginning August 1, 1958, consisting of the western half of the present District No. 4 and to be known as the South Central District No. 13. (The first vice-president of District No. 13 will be C. P. Knost of New Orleans, La., who was elected by the Board at this meeting under the provisions of C-26); (3) to change the period for paying dues, as heretofore mentioned under "finances"; (4) to remove the requirement for the publication in *Electrical Engineering* of the names of applicants for the grade of Member; (5) to define more broadly the duties and authorities of the Finance Committee; (6) to redefine the scope of the Education Committee; and (7) to include the Volta Scholarship Trustees as a part of the Professional Development and Recognition Department.

### Institute Affairs

Twelve Members were elected to the Fellow Grade. Appointment of a committee to plan the celebration of the 75th Anniversary of the founding of the Institute in 1959 was announced. A draft of a completely revised Constitution was received and studied by the Board. Action was postponed. A comprehensive plan for reorganization of the technical and publications structure of the Institute to integrate the Section Technical Groups with the Institute Divisions and Technical Committees was received and referred to the appropriate committee. Invitations were received to hold Board meetings at Sacramento, Calif., in August 1958, and at Atlanta, Ga., in May 1959. The next meeting of the Board was set for April 30, 1958, in Washington, D. C.

## Announcement of Bylaw Amendments in Effect

On October 11, 1957, the Board of Directors of AIEE voted into effect the following bylaw:

*B126* New and amended bylaws shall become effective on the first day of August following their adoption unless otherwise specified by the Board of Directors. In the latter case, a prominent announcement shall be made in *Electrical Engineering*.

At its meeting of February 7, 1958, the Board specified that the following bylaw amendments should become effective as of that date.

*B20* (See *Organization Manual* 1957-58, page 120)
The first paragraph of this bylaw is amended for the purpose of making the period for paying dues conform to the requirements of modern practice in advertising sales, and to simplify financial and membership records and controls. The bylaw, as amended with the essential changes in italics is as follows:

> A bill for annual dues shall be mailed to each member on or about May first. On *or about* August first, November first, and February first, notices shall be sent to those in arrears. The annual dues bill and the quarterly notices sent to those remaining in arrears shall have B19, 20, 21, and 23 of the Bylaws printed on the reverse side. *Any member whose current year's dues remain unpaid as of October first, and who has been mailed* Electrical Engineering *for the months May through October will be removed from the publications mailing list. Upon subsequent payment of his dues he will be restored to the publications mailing list and receive all issues from that date on. Issues during this interval shall be considered forfeited and will not be supplied unless requested.* Any member remaining in arrears on the following May first shall be placed on the Suspended List, and shall be debarred from enjoying *membership* privileges until reinstated. At the first meeting of the Board of Directors in the fiscal year, the Secretary shall submit to the Board of Directors a list of the delinquents for its action thereon.

*B60, 60.1, 60.2, and 60.3* (See *Organization Manual* 1957-58, page 125) These bylaws have been amended to read as follows:

> *B60* Student members may be admitted to the Associate Member or Affiliate grade without payment of entrance fees, as prescribed in these Bylaws, where eligible status has been attained by graduation. To take advantage of this saving, annual dues must be paid before the end of the fiscal year.
>
> *B60.1* Associate Member grade. Student Associates in good standing may be admitted to this grade upon written request, certification of graduation, and character report.
>
> *B60.2* Certification of Graduation. This certification as prescribed in B60.1 may be made by the Student Branch Counselor, an administrative officer of the school, or by the student by means acceptable to the Board of Examiners.
>
> *B60.3* Affiliate grade. Student Affiliate admission to this grade requires the same procedure outlined in B60, 60.1, and 60.2.

## Formation of New Section Announced at AIEE Section Representatives Meeting

PROMINENT among the many important items on the agenda of the Section Representatives Meeting, held Tuesday, February 4, 1958, during the AIEE Winter General Meeting, was the announcement of the formation of the new Northeastern Wisconsin Section—the 112th Section of the Institute.

The meeting was called to order by the presiding officer, H. H. Sheppard, chairman of the AIEE Sections Committee. Also seated at the speakers table was W. E. Scholz, secretary of the Sections Committee.

After the introduction of some distinguished visitors present at the meeting, including W. B. Morton, chairman of the Administrative Department, Mr. Sheppard remarked briefly on the program of Section activities and problems to be discussed during the all-day meeting.

### Membership Activities and Transfers

In a discussion of membership activities, H. R. Heckendorn, chairman of the Membership Committee, stressed the point that keeping present members is a more difficult job than getting new members.

This year, membership applications are running 10% higher, but delinquent members are a growing problem, with the major losses occurring in the area of the 6-year associate member. In an effort to retain these members, Mr. Heckendorn suggested that the names of the delinquents be made known to the particular membership committee which would then work in co-operation with the transfers committee to have them transferred if possible to member grade.

Mr. Heckendorn noted that, in order to encourage new membership, the month of November had been designated as "Membership Month." This feature received good publicity from several sources including *Electrical Engineering* (November 1957, p. 996), but the results are not yet known.

In discussing membership transfers, Charles Concordia, chairman of the AIEE Transfers Committee, stated the importance of having a transfers committee in each Section. This would help to alleviate the problem of an engineer remaining an associate member indefinitely.

Mr. Concordia explained that in order to assist the transfers committees of the individual Sections, the setup of the National Transfers Committee is such that it includes one or more members from each District. This member is expected to maintain contact with the Section transfers committees within his District.

### United Engineering Center

Mr. Sheppard introduced L. M. Goldsmith of the Philadelphia Section who has been appointed by AIEE President W. J. Barrett as chairman of the AIEE Member-Gifts Campaign for the new United Engineering Center (see p. 349 of this issue).

### Section and District Changes

An important announcement by Mr. Sheppard concerned the formation of the 112th Section of the Institute—the Northeastern Wisconsin Section which was formerly the Fox River Valley Subsection of the Milwaukee Section.

E. F. Woytych, chairman of the new Section, remarked on the tremendous growth of the Fox River Valley Subsection since its formation in 1947, which made it easy to obtain the 50 signatures required to assume Section status.

The territory of the new Northeastern Wisconsin Section will include: 16 counties in Wisconsin and 13 counties in Michigan to be transferred from the Milwaukee Section, and 6 counties in Wisconsin to be transferred from the Madison Section.

Other changes in Section territory in District 5 involve the transfer of 7 counties in Wisconsin from the Madison Section to the Minnesota Section; the transfer of Gogebic County, Mich., from the Milwaukee Section to the Arrowhead Section; and the transfer of Iron County, Wis., from the Madison Section to the Arrowhead Section.

Mr. Sheppard also mentioned the split in District 4 which will be effective next August. The eastern half will remain District 4 and the western half will form District 13.

### Institute Finances and Section Allotments

L. F. Hickernell, AIEE treasurer, spoke briefly on the state of Institute Finances. He mentioned some increased expenses including the rise in printing rates, and stated that the AIEE is facing a reduced budget because of business conditions, a fall off in advertising, and other factors.

J. R. Kerner, chairman of the Subcommittee on Section Finances, presented the Subcommittee's report on its study of Section allotments and finances based on questionnaires sent to the Sections.

Temporary relief of Section financial difficulties has been provided by some measures taken by the AIEE Board of Directors: an allotment of $1.20 per member above the basic Section allotment which stops if the member becomes delinquent but continues retroactively when the member becomes active again; credit allowance for additional meetings held above the reported top number of 30, in an effort to encourage the formation of technical groups; and remittance to the Section of entrance and transfer fees for members within the Section territory.

Mr. Kerner gave tentative estimates of how this aid would increase various Section allotments. However, he said that the Subcommittee would like further opportunity to consider the matter and to decide whether the allotment formula is right for the Sections.

### Group-Dynamics Question Period

Mr. Sheppard reviewed the essentials of group-dynamics procedure, a method of encouraging wide and lively participation in a discussion. The Section representatives then formed small groups each of which, in a 10-minute "buzz session," chose one or more questions relating to the items on the morning's agenda.

Some of the questions suggested for discussion concerned: certificates for society members contributing to the building fund, and other campaign details; long-range plans for overcoming the Institute deficit; and the possibility of Sections participating in the surplus from national technical conferences.

### Public Relations Workshop

The afternoon session of the Section Representatives Meeting began with a Public Relations Workshop presided over by J. A. Parrott, chairman of the AIEE Public Relations Committee, who stressed the need for more work on the Sections' part in the area of public relations for the engineering profession.

R. C. Mayer, Jr., of Raymond C. Mayer & Associates, public relations consultants to the Institute, reviewed public relations activities and some of the tools which can aid the Sections. These include: a Section Newsletter, the President's Newsletter, and a new publicity kit which answers questions most frequently asked by the Sections about the preparation and placing of material.

Following Mr. Mayer's general review, R. W. Lewis, chairman of the Radio and Television Publicity Committee of the Boston Section, described his Section's public relations organization which is divided into four committees: year book, internal publicity, radio and television publicity, and newspaper and trade paper publicity.

R. N. Wagner, chairman of the Pittsburgh Section, discussed the various activities of that Section in the area of public relations, including a Pittsburgh Section Newsletter which is popular with Section members.

T. H. MacCauley, a member of the

ELECTRICALLY-OPERATED WALLS AND DOORS
HOME WATER PURIFIERS
TAPE RECORDERS SOUND & PICTURES
AUTOMATIC STOCK KEEPERS

**T. H. MacCAULEY, chairman of the Radio Committee of the AIEE Philadelphia Section, demonstrates some public relations techniques in a talk given at the Public Relations Workshop which was a feature of the Section Representatives Meeting.**

National Public Relations Committee and of the Philadelphia Section Radio Committee, urged Sections to pursue a vigorous public relations program and as an example gave a dynamic presentation of the many uses of electricity in present day society. His speech was accompanied by dramatic visual aids designed to hold the attention of the audience, including luminous figures of Franklin and Edison, and a huge illuminated map of the United States which showed power lines and stations linking various parts of the country.

### Student Branch Activities

In his discussion of Student Branch activities and Section–Student Branch co-operation, J. W. Rittenhouse, chairman of the Student Branches Committee, spoke of several problems which must be solved in order to increase Student Branch membership. One such problem results from the classification of AIEE as a power organization. To overcome this difficulty, proper emphasis should be placed on other aspects of AIEE, such as electronics and communications, so that students interested in these and other fields are not drawn to other organizations.

Among the suggestions for encouraging Student Branch activity offered by Mr. Rittenhouse to the Sections was the organization of an annual "Father-Son Dinner," during which Section members—"fathers"—are paired off with Student Branch members—"sons." The success of this event depends on extensive predinner preparations which permit the "father" and the "son" to become acquainted before the dinner.

Another way in which the Section student activities committee can aid the Student Branch is by helping the District vice-president to select the proper counselor for each Branch.

What a particular counselor is doing to help the Institute hold on to the graduating student member was demonstrated by R. R. Krezdorn, counselor at the University of Texas. He furnishes the secretary of a particular Section with the name and address of any graduating student moving into that Section territory. It is then up to the Section to contact the prospective member.

### Registration of Engineers

F. H. Knapp, chairman of the Registration of Engineers Committee and a member of the Sections Committee, spoke on the co-operation of Sections in encouraging AIEE members to become registered professional engineers.

Mr. Knapp mentioned several measures planned by the Committee. These included: encouraging Section chairman to form registration of engineers committees, asking Student Branch counselors to work with seniors in electrical engineering toward taking the examination, and distributing the pamphlet "Next Step—Registration" to each AIEE member.

### Section Educational Activities

The discussion of educational activities at the Section level was begun by F. C. Weimer of the Columbus Section. Dr. Weimer said that his Section's program of educational courses, which has been very successful, presents an opportunity to aid Section finances and helps to fill the need for up-to-date technical information.

R. W. Gillette, chairman of the New York Section, described the general organization of the New York Section educational program which offers: review study groups—for professional engineer examinations, individual improvement study groups, and special study groups. J. C. Hoyt presented the details of the educational program of the Power and Industrial Division, one of the five New York Section divisions which offers this educational service to engineers.

### Section Technical Groups

W. R. Clark, AIEE director, spoke on the co-ordination of Section technical groups and Institute technical committees through the Technical Operations Department. These remarks are fully covered in the report on the Forum of Technical Committee Chairman on p. 349 of this issue.

## Dr. Goldsmith Named Chairman of AIEE Member-Gifts Campaign for New Center

AIEE PRESIDENT W. J. Barrett has appointed Dr. L. M. Goldsmith (F '47) of the Atlantic Refining Company, Philadelphia, Pa., as chairman of the AIEE Member-Gifts Campaign for the new United Engineering Center to be erected on United Nations Plaza in New York City.

During the Winter General Meeting of the Institute, Dr. Goldsmith spoke to the AIEE Section Representatives on the significance of the new Center as a tremendous opportunity for unity in engineering. He expressed the thought that the project might develop into United Engineering Societies which are needed by the profession. With the aid of slides, Dr. Goldsmith described the proposed building and its site on United Nations Plaza between 47th and 48th Streets in New York City.

The total cost for the new building and the site is estimated at $10 million. The present resources of United Engineering Trustees, Inc., and proceeds from the sale of the present Engineering Societies building are estimated at $2 million. The remaining $8 million will be sought from: business and industry, $5 million; and from individual society members, $3 million. Since AIEE has the largest membership, it also has the largest quota to fill.

To serve on the AIEE Member-Gifts Campaign Committee, Dr. Goldsmith appointed: H. H. Sheppard vice-chairman, and W. E. Scholz secretary. The main Fund Raising Committee is to consist of all the District vice-presidents and all the Section chairmen. These officers are to appoint committees within their Sections. Dr. Goldsmith offered general suggestions, but he stated that the specific procedure of these internal committees will be up to the Sections. He said that members should be contacted personally and that direct mail contact has no place in the campaign. Dr. Goldsmith believes that if people can be properly impressed with the importance of the project, there will be no difficulty in obtaining the necessary funds.

L. M. Goldsmith

## Institute Reorganization Discussed at Forum of Technical Committee Chairmen

THE THEME of the Forum of Technical Committee Chairmen held in New York, N. Y., on February 6, 1958, was the projected reorganization of the Institute as a vehicle through which engineering productivity and creativity could be enhanced in this age of Sputniks. Hendley Blackmon, chairman, Technical Operations Department (TOD), was the moderator for a panel of seven who discussed different aspects of "up-to-the-minute information for Technical Committee chairmen" within the framework of the meeting's theme.

### Reorganization Plan

AIEE President W. J. Barrett, as the honorary chairman for the evening, opened the discussion with a broad description of the proposed Institute reorganization, a part of which is of direct concern to Technical Committee chairmen and is already in operation. This is the organization of the committee structure into five Departments each of which is presided over by a departmental board that conducts the business of the Department and makes necessary decisions within the framework of the broad policies laid down by the Board of Directors. Each departmental board consists of the chairmen of the General Committees or Technical Divisions in the Department plus a few members at large.

### Role of the Technical Committees

President Barrett stressed the need at this time for increasing the over-all technical proficiency of the engineer on which, in the last analysis, the prestige and recognition of the engineer rests. Whatever standing and respect the AIEE hopes to achieve will result basically from the excellence of its technical work—the quality of its publications, the authority and usefulness of its standards, the progressive and stimulating quality of the papers and discussions at its meetings.

All of this comes right back to the Technical Committees, President Barrett pointed out. They are responsible for the discriminating review and selection of papers and for the initiative in respect to standards. Further, Technical Committees composed of recognized authorities will command respect and exert influence on the technological development in industry and national security. Failure to grow in membership and activity in proportion to the expansion of the technological needs of the country can only reflect the Technical Committees' and Divisions' lack of imagination and strong leadership.

### Technical Committee Personnel Selection

L. F. Hickernell, past chairman of four Technical Committees and nominee for the AIEE presidency, drew upon his experience as past-president of the efficiently operated Insulated Conductors Committee to formulate a group of suggestions on personnel selection:

1. Review the Subcommittee organization to determine whether it covers the Committee scope adequately.
2. In general, there should be approximately 10 standing Subcommittees. It is preferable to establish too many than too few for the practical reason that, if one or two are relatively inactive for one reason or another, the effect is less on the Committee's over-all activity.
3. Establish definite co-ordinated scopes for each Subcommittee.
4. Select chairmen for each Subcommittee, insofar as practical maintaining a balance among user, manufacturer, and general interest. If possible, these chairmen should have definite interest in the specific area covered by the Subcommittee.
5. Select a vice-chairman and secretary. Succession from secretary to vice-chairman to chairman has proved very effective in several Committees, and provides for emergencies. Establish a rotation of the chairmanship between user and manufacturer (and general interest, if possible).
6. Organize an "Administration Subcommittee," consisting of the chairman, vice-chairman, secretary, past-chairman and Subcommittee chairmen. This group forms the nucleus of the Committee personnel.
7. Obtain recommendations from each Subcommittee chairman for personnel of his respective Subcommittee.
8. Combine and co-ordinate these recommendations to obtain balance by affiliation and geographical distribution. Limit Subcommittee assignments to two per Committee member. Add members of known ability and experience plus a willingness to participate actively in committee work. If affiliation unbalance exists in the combined list, and a potential candidate is not known, write to the engineering executive of the missing organization and request his recommendations. While there is no "official" limit, generally 50 is considered a reasonable maximum number of members of the main Committee. All Committee members must be members of the Institute.
9. In addition to Committee members, specialists (who need not be Institute members) may be appointed to Subcommittees and designated "Special Members," or "Subcommittee Members." Limit Subcommittee personnel to about 20 to avoid ineffectiveness. There is no limit to the aggregate number of Subcommittee members.
10. Review the current literature for authors of papers and articles who may be potential candidates for Committee memberships in the future. Bibliographies compiled by Committees may be useful for this purpose.

### Special Technical Conferences

The rapid growth of Special Technical Conferences has brought to the fore many questions that are pressing for solution. A Special Technical Conference Subcommittee has been set up to establish ground rules for such conferences. W. A. Lewis, a representative of this Subcommittee outlined the scope of the Subcommittee's function which encompasses the following: Statement of the Committee's purpose, co-ordination with other societies, allocation and control of funds, a manual of procedure, relation of headquarters activities to conference activities, selection of meeting sites, publication of proceedings, awards, travel expenses for special guests, and distribution of income.

To date, the only recommendation the Subcommittee has made, Dr. Lewis reported, is that national committees may organize meetings through technical conferences on special subjects and promote attendance at meetings with other groups. Contributions from the Institute for these meetings should equal those to General Meetings.

### Regulation of Meeting Exhibits

With the deletion by the Board of Directors of Bylaw 34, which prohibited the advertising of commercial products at Institute meetings, a subcommittee was appointed in TOD to determine a uniform procedure for co-ordinating the showing of exhibits at General Meetings, District Meetings, and Special Technical Conferences.

Some of the basic considerations governing the adoption of this uniform procedure were outlined by C. T. Hatcher, vice-chairman, TOD.

These considerations are:

1. If a profit is derived by AIEE from the exhibits should it be retained by the local AIEE organization or should it become a part of the AIEE general fund.
2. Does the collection of fees or percentages of fees affect the AIEE from a tax standpoint. Information obtained from our lawyers indicates that inasmuch as we are a nonprofit organization this will not affect our tax status.
3. Should the exhibits be of an educational nature and be related only to the technical program of the meeting. This might easily apply to conferences but would be difficult to apply to General Meetings.
4. Should exhibits be of a commercial nature and have no direct association with the technical program of the meeting.
5. If the exhibits are of a purely commercial nature should AIEE participate in the fees paid by the exhibitors or should the exhibits be used only as a means to increase attendance at the technical sessions.
6. What responsibility should the Institute assume in connection with underwriting any laws in connection with a show.

### Processing Transactions Papers

A. C. Muir, chairman, TOD Manual Subcommittee, issued a progress report on the activity of his Subcommittee in preparing the "Processing of Papers" section of the TOD Manual. A draft of this section was circulated to the members of TOD on November 1, 1957, for consideration for a 30-day period. The suggestions received were incorporated into the section and it was mailed out for trial use December 6, 1957, to all chairmen, vice-chairmen, and secretaries of the Technical Committees, to the members of TOD, to the Treasurer, and the members of the Manual Subcommittee. The trial use period was to end with the 1958 Winter General Meeting. The Subcommittee received some 29 questions and suggestions for changes and began work on incorporating these changes into the "Processing of Papers" section.

### Manuscript Reviews

I. S. Coggeshall described the new papers review forms—RF-1, white; RF-2, yellow; RF-3, green; RF-4, pink—that were designed to tie in with the latest decisions of TOD and the new TOD Manual section on processing of papers. They also embrace a system of merit evaluation which avoids the use of weighted figures formerly employed. The forms will be sent out to Technical Committee chairmen by E. C. Day at Institute headquarters, through whom all papers are submitted.

Mr. Coggeshall expressed the belief that the new forms will facilitate and further systematize papers reviews.

### Prize Awards for Transactions Papers

The role of the Technical Committees in supplying candidates to share in the $700 prize money distributed annually for outstanding transactions papers was stressed by B. G. A. Skrotzki, chairman, Prize Awards Committee. Although this

Committee officially awards the prizes, its actions are generated at the "grass roots" level, he pointed out.

The papers review form has been designed deliberately to jog the chairman of the Technical Committee into weighing the prize potential of every paper he recommends for transactions publication.

Mr. Skrotzki noted the publicity value of these prize-award activities, pointing out that newspapers are much more likely to give space to announcement of award winners than the revelation of important technical achievements obscure to the public. He also called attention to the availability of a $100 prize and certificate for transactions papers sponsored by the General Committees and articles appearing in *Electrical Engineering*.

#### Transactions Papers Deadlines

The handling of transactions papers is based on the basic objective of the AIEE which is "the advancement of the theory and practice of electrical engineering and of the allied arts and sciences and the maintenance of a high professional standard among its members." The mechanical procedure necessary to follow this basic policy was outlined by A. C. Muir as follows:

1. Papers are reviewed and accepted by the cognizant Technical Committee; or revised by the author, if so required.
2. Papers are preprinted (for preparation of discussion) from the author's original manuscript.
3. Papers are presented at a recognized meeting.
4. Discussion, if any, is sent to the author.
5. The paper, discussion, and rebuttal are published in the appropriate Bimonthly.

The three requirements which determine deadlines are: (1) printing of the program for the meeting in *Electrical Engineering*, (2) sale of preprints before meeting, and (3) mailing of meeting announcement to members.

Mr. Muir displayed a chart which showed total times arrived at for submission of manuscripts for each of the three aforementioned requirements to be: for TPs—110, 98, and 92 days respectively; for CPPs—84, 71, and 65 days respectively. The longest time naturally controls the deadline for the meeting. Steps are now being considered to bring the deadline for TPs back to 90 days before the meeting and the deadline for CPs to 65 days before the meeting.

#### Technical Group Activities

W. R. Clark, chairman, Technical Groups Subcommittee, discussed Technical Group activities in the AIEE.

As the result of the recommendations of a committee appointed by the President two years ago under the chairmanship of J. C. Strasbourger, two important actions relative to Technical Group activities were taken:

1. A survey of the membership of the Sections was undertaken to determine interest in the formation of new Technical Groups.
2. A TOD representative for each District was appointed to sparkplug technical activities in the Sections and to help in the closer timing of the activities of the Technical Committees of the Institute with the Technical Groups of the Sections. A TOD representative is a nonvoting member of TOD.

Since these two steps were taken late in 1956, 45 new Technical Groups were established in 65 Sections within the first three months. At present, there are over 200 Technical Groups in operation.

Since the Fall of 1956, when these assignments were first suggested, they have been expanded; in some cases, by suggestions received by the representatives themselves. Some factors are:

1. TOD Representatives receive a travel allowance for attending a District Meeting so that they can be in closer touch with Section Technical Group activities.
2. TOD should interest the counselors at the colleges in Technical Group activities, and get them to show the students how these specialized groups can best serve their interests technically while the Section organization keeps them in touch with all other fields of engineering.
3. TOD Representatives should encourage the formation of Technical Groups in colleges as a student organization.
4. The TOD Representative should work in close co-operation with the chairman of Technical Groups of the Section. One Section has established a District Technical Commitee with the TOD Representative as Chairman and a representative from the Technical Groups of each section as a member. The chairman of the District Committee on Student Activities is also a member. This idea should be expanded to other Districts.
5. They should interest young engineers in AIEE activities.

In order to further Technical Group activities, M. S. Coover, last January, appointed an Ad Hoc Committee to determine ways and means for providing a closer tie-in between the activities of the Technical Groups of the Sections and the Technical Committees of the Institute.

As a result of several meetings of that Committee, the following recommendations were considered by the Board:

1. The Section Technical Group chairman, or his representative, be appointed by the president as a liaison representative of the appropriate Institute Technical Committee.
2. Standardization of names of committees, subcommittees, and groups within Sections and Technical Committees is desired. It is recommended that for a start, Technical Committee nomenclature be used, insofar as possible.
3. The Section Technical Group representative on the Institute Technical Committee be identified in the "Organization Manual" with his Section affiliation.
4. The Section report forms, which are made out at the present time by the Technical Group representative in the Section, should be revised and amplified to include synopses of Technical Group activities, including copies of papers presented if available, and items of importance which would be of interest to other Sections or to the Institute Technical Committees. Copies of this report should be sent to: the chairmen of the Technical Committees or the Division chairmen, if there is not an appropriate Institute Technical Committee; to the TOD District representative; to the Section secretary, as at present; to District vice-presidents; to Headquarters, as at present.
5. The chairmen of Institute Technical Committees use this information in their reports for furthering the work of their committees.
6. Reports that are sent to Headquarters be used for correlating information and distributing to the general membership the information prepared which should include items from the minutes of Institute Technical Committee meetings as well as the Technical Groups.
7. This be promptly edited and published in appropriate form. Items of general interest being edited and published in *Electrical Engineering;* possibly in a new section under the heading "Technical Activities."
8. Headquarters staff be augmented to implement the foregoing recommendations.

"The Board voted that the report of the Ad Hoc Committee be received and referred to the TOD, the Publications Department, and the Administration Department; and that their reviews and considerations be co-ordinated by the Planning and Co-ordination Committee, with a final recommendation brought to this Board; and that the program be immediately activated to the extent that the Board authorizes the TOD to request from the Sections the names of their respective chairmen of local Technical Groups, and further to request that they furnish TOD with reports on the activities of local Technical Groups.

"It was the consensus of the Board that

### Bimonthly Publications

The bimonthly publications, *Communication and Electronics, Applications and Industry*, and *Power Apparatus and Systems*, contain the formally reviewed and approved numbered papers presented at General and District meetings and conferences. The publications are on an annual subscription basis. In consideration of payment of dues, members (exclusive of Student members) may receive one of the three publications; additional publications are offered to members at an annual subscription price of $2.50 each. Nonmembers may subscribe on an advance annual subscription basis of $5.00 each (plus 50 cents for foreign postage payable in advance in New York exchange). Single copies, when available, are $1.00 each. Discounts are allowed to libraries, publishers, and subscription agencies.

the Ad Hoc Committee should continue its work."

### General Discussion

A discussion from the floor followed the panel discussions. Most of the discussion centered about the problem of transactions papers deadlines and the feeling that the rules to obtain papers for publication were unnecessarily complicated. One conferee noted that there are dual dates and dual specifications to meet for certain Special Technical Conferences such as the Nuclear Congress. Some felt a special effort should be made to disseminate the rules for the processing of papers throughout the membership. Questions were answered by Hendley Blackmon and the panel members. A vote of thanks was extended to the panel before adjournment.

# Young Electrical Engineers Honored at Eta Kappa Nu Awards Dinner

THE BEST ATTENDED Eta Kappa Nu Recognition Awards Dinner in many years was held at the Cornish Arms Hotel, New York, N. Y., February 3, 1958. The award bowl which remains on permanent display in the Trophy Room of the AIEE was presented to R. P. Crago, who was chosen the outstanding young electrical engineer of the year, and honorable mention certificates were given to Dr. W. R. Beam and G. W. Stagg. R. I. Wilkinson was presented with a plaque bearing the citation, "In tribute to his initiative in creating and developing the Eta Kappa Nu Recognition of outstanding young electrical engineers." President C. T. Koerner of Eta Kappa Nu presided and introduced the speakers.

### The Award

The award as the outstanding young electrical engineer in 1957 was made to R. P. Crago with the citation, ". . . by virtue of his outstanding leadership in the planning and development of air defense facilities and his unselfish participation in the civic and church activities of his community." Receiving his B.S. degree in E.E. from Carnegie Institute of technology in 1948 and his M.S. degree from the California Institute of Technology in 1949, Mr. Crago joined the International Business Machines Corporation (IBM) where he rose rapidly to his present post of director of engineering, Military Products Division. His career was outlined by T. V. Learson, vice-president and group executive, IBM, who described his progress from project engineer to manager of engineering design and then to chief engineer in charge of the SAGE Project for IBM, from which post he was transferred to the Kingston plant to manufacture the product he had designed. Recently, Mr. Crago was advanced to his present post as director of engineering of the Military Products Division. He has skillfully improved communications and applied engineering techniques so that engineers of other fields such as business law, finance, public relations, etc., may better understand them. Notwithstanding the demands of his professional career, he has been active in community affairs as church elder, teacher of a church school class, and a member of the Board of Trustees of the Kingston Hospital, and a member of the board of directors of the Kingston area Chamber of Commerce.

On accepting the award, Mr. Crago paid tribute to his parents, Dr. Teare and the faculty at Carnegie Tech, his wife, and co-workers at IBM who had helped make his outstanding career possible. He spoke of his nine years' experience, during which there occurred the rapid rise in the field of digital computation, with solid-state devices—first diodes, then magnetic cores, then transistors—taking the place of vacuum tubes which helped bring about the computing revolution of today. He described the functions of the computer in the SAGE system where data from remote defense points, from all the defense mechanisms in the area entered by an enemy, are fed into the computer, and the computer automatically computes or recommends a course of action and alternative ways of meeting the threat. Once the military operator chooses a course of action, this is indicated to the computer which sends commands to planes and missiles directing them to carry out the tactic chosen.

### Honorable Mentions

Honorable mention was awarded to W. R. Beam with the citation, ". . . by virtue of his extraordinary analytical and technical competence in microwave development, his administrative ability, and his exceptional activity in community and professional affairs." Dr. Beam received his B.S., M.S., and Ph.D. degrees from the University of Maryland where he served as an instructor while working for his graduate degrees. He joined the David Sarnoff Research Center in 1952, made a number of significant advances in the field of microwave electron tubes and was promoted to manager of microwave advance development in the Radio Corporation of America (RCA) Tube Division. National recognition for his work was attained in the field of fluctuation noise reduction in traveling wave tubes, and he has made significant contributions to television picture reproducer electron optics. Dr. Beam also was very active in community affairs in Hamilton Township, N. J., and he is an accomplished violinist.

On acceptance, Dr. Beam paid tribute

**SHOWN at the Eta Kappa Nu Awards Dinner (above, *left*) are: (*left to right*) Dr. W. R. Beam, honorable mention award winner; C. T. Koerner, president of Eta Kappa Nu; R. P. Crago, chosen outstanding young electrical engineer for 1957; and G. W. Stagg, honorable mention award winner. Above, right: R. I. Wilkinson (*left*) receives a plaque which pays tribute to ". . . his initiative in creating and developing the Eta Kappa Nu Recognition of outstanding young electrical engineers" from President Koerner (*right*) during the Awards Dinner.**

to his family, the professors in college, and company associates who had helped him to attain his success.

Honorable mention also went to G. W. Stagg with the citation, ". . . by virtue of his notable contributions to the economic study and planning of electric power systems, and his many civic, cultural, and other achievements." Mr. Stagg was graduated from Massachusetts Institute of Technology in 1948 and joined the American Gas and Electric Service Corporation. He obtained the degree of M.B.A. in 1955 from New York University, majoring in banking and finance, and public utility management and regulation. He has done pioneer work in the application of digital computers to power system analysis. At present, he is working on the application of digital machines to problems involving power flow, short circuit instability, and loss formula calculations, which already has reduced the cost of making power flow studies by 50-75%. He is active in the Big Brother movement in New York City and has numerous hobbies.

The honorable mention certificates were presented by I. S. Coggeshall, director of International Communications, Western Union Telegraph Company, who served as chairman of the Jury of Award. Other members who served on the Jury were C. J. Beller, A. V. Haeff, R. R. Hough, W. E. Kock, and J. M. Wallace. The chairman was impressed with the soundness of the system of screening and scoring the large number of highly qualified candidates.

### Feature Address

Concluding the presentation ceremonies, Dr. E. W. Engstrom, senior executive vice-president, RCA, gave a feature address, "Science and Technology in a Changing Environment." The history of scientific research was reviewed up through the time when individual inventiveness was surpassed by scientists—engineer teams and when the accelerated pattern brought about by World War II caused stimulated basic research to be consumed by rapid technical developments. The speaker drew attention to the need for more basic research in which the National Science Foundation could play an increasingly important role. Although recognizing the need of military preparedness, Dr. Engstrom cautioned against losing sight of the broader aspects of basic research and the greater need for full understanding between scientists and the public. Full text of the address appears on pp. 283-87 of this issue.

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# East Central District Meeting Will Be Held in Huntington, W. Va.

THE East Central District Meeting of AIEE will be held in Huntington, W. Va., May 13-15, 1958. Huntington, the largest city of West Virginia, is located on the Ohio River at the tri-state area of Kentucky, Ohio, and West Virginia. In this area, known as the Central Ohio Valley, industry has a great future in metallurgy, chemistry, and mining, as well as in many other fields. Located in this well-developed area are many recreational parks, swimming pools, golf courses, and camping, fishing, and hunting areas. Also offered are many cultural advantages.

### Technical Program

In the technical program, which will have approximately 20 sessions, one will find a session on Industrial Lighting, with papers on "The Fundamental Principles of Industrial Lighting," "Application of Super-Hi Lamps and High Frequency to Interior Lighting," and two other papers on "Industrial Lighting." There will be sessions on Cathodic Protection of Underground Structures and Extruded Plastics as a Cathodic Protection, and a morning session on A-C Distribution in Underground Mines, with papers on "Why Consider A-C Mining Underground," "Power Distribution for A-C Mining," and "National and State Electrical Requirements for A-C Mining."

A session on Safety will be held, with papers on "Some Aspects of Safety in the Use of Electrical Equipment in Coal Mines," and new data on "Resuscitation and Electrical Shock and Its Effects on the Human Body." One of the many interesting sessions will be on Computer Application in System Engineering, with technical papers on "Application of Digital Computers to System Planning" and "Economic Load Dispatching" with computers. The afternoon session on A-C Distribution in Underground Mines will have three papers on "Operation of an A-C Mine," and one paper on "A-C Powdered Mining Machines." In connection with mining industries, there will be a session on Equipment for the Coal Industry, with two papers on "Underground Lighting, Today and Tomorrow," and "Application of Electronics in Coal Mining."

Also scheduled is a session on communication, with papers on a "PBX Telephone Switchboard for Dispatching Service," "New Electronic Techniques in Communication," and "Some Features of Data Transmission." The Induction Heating session has papers on "Power Sources For Induction Heating," "Latest Developments in the Use of Induction Heating," "Dielectric Heating," and "Design of Inductors for Induction Heating."

To cover the field of metallurgy, there will be a session on Power Cables and Connectors, with papers on "Aluminum vs Copper for Industrial Cable Application," "Design of Aluminum Connectors," "Accelerated Test of Mining Machine Cables," and a paper on a new "ACSR Splicing Method."

### Social Program

The social program will start on the evening of May 12, with an "Early Bird" get-together. Other social events will include luncheons and dinners, with entertainment, plus a dance and floor show on the Steamer *Avalon* as it cruises on the Ohio River. One luncheon will be sponsored by the Portsmouth Subsection of the East Central District, and another luncheon will be sponsored by the Charleston, W. Va., Section of AIEE.

**ONE of the General Electric Company's *FGK-345*, 1,600-amp, 345-kv, oil circuit breakers with fault rating of 25 mva, interruption rating time 3 cycles, reclosing rating time 20 cycles. Top of bushing stands 26¼ feet above ground line. This oil circuit breaker is in service at Kyger Creek Plant 345-kv Switching Station which is one of the seven inspection trips planned during the East Central District Meeting.**

### Ladies Events

The ladies events will start with an open house followed by several luncheons, a hat show, bridge party, and several interesting tours. A tea will be held at the Huntington Art Galleries which is a combination museum and art workshop picturesquely located in the hills near Huntington. One of the tours will be to the Blenko Glass Company at Milton, W. Va., where the ladies will see glass furnaces and how handblown glass is made. They are also invited to accompany their husbands on the river cruise.

### Inspection Tours

One inspection tour planned will be to the Aluminum Producing and Fabricating Plant of Kaiser Aluminum and Chemical Corporation, which is located on 2,600 acres near Ravenswood, W. Va. Upon completion, this plant will be one of the largest integrated operations of its type in the nation. Another inspection trip will be the Chesapeake and Ohio Railway Company's Car Location Information Center, where the adaptation of teletype to car and train movement will be demonstrated. Other trips will offer observation of one of the largest newspaper press units, a tour of one of the largest power plants built by private enterprise, inspection of WSAZ-TV Studio, and a tour through the ARMCO Steel Corporation plant at Ashland, Ky.

## Summer General Meeting Provides Unique Features

The 1958 Summer General Meeting of the AIEE will be held in Buffalo, N.Y.—birthplace of electrical power—June 23-27. Here, in the heart of the world-famous Niagara region, and at the gateway to Canada, is concentrated a variety of industrial enterprises seldom found in other areas. Steel, chemicals, aircraft, automotive, and the great granaries of the nation are but a few of the industries represented. Now, with the advent of the Niagara power development, private and public utilities face a tremendous problem of transmission and distribution.

This redevelopment program forms an interesting background for the technical program of the Summer General Meeting, which will include papers covering transmission, distribution, and industrial use of this power.

One of the highlights of the Summer General Meeting will be a tour of the Niagara Frontier area, covering many points of interest. The trip will include a crossing of the Peace Bridge to Canada, a visit to the world-famous Oakes Gardens in Canada; and, of course, the Niagara Falls area.

An inspection trip of the Niagara Mohawk Huntley Station will provide an opportunity to visit one of the largest steam electric stations in the United States. The recent addition of Unit *67*, a 200,000-kw cross-compound unit, and the coming addition this year of the Unit *68*, will raise the output capability of this station in excess of 970,000 kw, 60 cycle. In addition, there exists over 200,000 kw of 25-cycle generation.

In conjunction with these new units, a 230,000-volt transmission line was built to handle the bulk power.

Programming now under way indicates that this 1958 Summer General Meeting will provide noteworthy technical and general interest subjects.

### Air Transportation Conference

The Air Transportation Committee of the AIEE has been sponsoring annual technical conferences for more than 10 years. The activity at these conferences has grown steadily and at last year's Conference in Dayton, Ohio, 60 technical papers were presented and over 400 engineers attended the Conference. This year, the Air Transportation Conference has been scheduled for June 25-27, 1958, during the AIEE Summer General Meeting at the Hotel Statler in Buffalo, N. Y. At present, there are over 70 technical papers under preparation by leading engineers in the aircraft industry and the armed forces. The papers are primarily concerned with the following subject areas: high temperature; reliability; missile power packages and power supply parameters; electrical ground support; instrumentation for precise requirements (voltage, wave form, etc.); and radiation effects.

For reservations, address Hotel Statler, Buffalo, N. Y.; mention the Conference in the letter. For information on business or program for the meeting, contact S. H. Hanville, Chairman Arrangements Committee, Jack & Heintz, Inc., Cleveland 1, Ohio.

**AN INSPECTION TRIP of the Niagara Mohawk Huntley Station during the AIEE Summer General Meeting will provide an opportunity to visit one of the largest steam electric stations in the United States.**

## Report of Nominees for Institute Offices

At its meeting held February 3, 1958, the AIEE Nominating Committee selected the following official nominees for election to Institute offices for terms beginning August 1, 1958.

*For President:*

L. F. Hickernell, vice-president, engineering, Anaconda Wire & Cable Company, Hastings on Hudson, N. Y.

*For Vice-Presidents:*

L. C. Holmes, research director, Stromberg-Carlson Company, Rochester, N. Y. (District No. 1)

J. R. Kerner, distribution apparatus manager, Westinghouse Electric Corporation, New York, N. Y. (District No. 3)

R. B. Gear, director of purchases, Commonwealth Edison Company, Chicago, Ill. (District No. 5)

I. T. Monseth, regional engineering and service manager, Westinghouse Electric Corporation, St. Louis, Mo. (District No. 7)

J. M. Nelson, executive assistant superintendent, Seattle City Light, Seattle, Wash. (District No. 9)

W. H. Chase, vice-president, Ohio Bell Telephone Company, Cleveland, Ohio (District No. 11)

*For Directors:*

W. A. Lewis, research professor of electrical engineering, Illinois Institute of Technology, Chicago, Ill.

N. F. Rode, professor of electrical engineering, Agricultural & Mechanical College of Texas, College Station, Texas

E. C. Starr, chief engineer, Bonneville Power Administration, Portland, Oreg.

*For Treasurer:*

C. H. Linder, vice-president, engineering services, General Electric Company, New York, N. Y.

The Nominating Committee, in accordance with the Constitution and Bylaws, consists of one representative of each geographical District, one representative of each technical division, and other members chosen by and from the Board of Directors not exceeding in number the number of Technical Divisions.

The Constitution and Bylaws of the Institute require publication in *Electrical Engineering* of the nominations made by the Nominating Committee. Provision is made for independent nominations as indicated in the following excerpts from the Constitution and Bylaws:

*Constitution:* C33. Independent nominations may be made by a petition of twenty-five (25) or more corporate members sent to the Secretary when and as provided in the Bylaws; such petitions for the nomination of Vice-Presidents shall be signed only by members within the District concerned.

*Bylaws:* B28. Petitions proposing the names of candidates as independent nominations for the various offices to be filled at the ensuing election, in accordance with C33 (Constitution), must be received by the secretary of the Nominating Committee not later than March 15 of each year, to be placed before that committee for the inclusion in the ballot of such candidates as are eligible.

On the ballot prepared by the Nominating Committee in accordance with the Constitution and sent by the secretary to all qualified voters on or before April 15 of each year, the names of the candidates shall be grouped alphabetically under the name of the office for which each is a candidate.

A list of members of the Nominating Committee appeared in the January 1958 issue of *Electrical Engineering*, pp. 82-83.

To enable those institute members not acquainted personally with the nominees to learn something about their engineering careers and their qualifications for the Institute offices to which they have been nominated, brief biographic sketches are included in the "AIEE Personalities" columns of this issue.

## Plans Made for Appliance Technical Conference

The 9th Annual AIEE Appliance Technical Conference will be held in Chicago, Ill., May 26-27, 1958. This Conference is sponsored by the AIEE Domestic and Commercial Applications Committee.

The tentative technical program for the Appliance Technical Conference follows.

### Monday, May 26

**Morning Session**

**Higher Voltage and Grounding—An Appliance Problem.** *H. H. Watson*, General Electric Company

**Electrified Fibrous Air Filters.** *J. W. Thomas, E. J. Woodfin*, Whirlpool Corporation

**Water and Appliances.** *E. J. Zimmer*, Plumbing Testing Laboratory, City of Chicago

**Lunch 12:30**

**Afternoon Session**

**Noise Control of Domestic Appliances.** *Dr. R. Plunkett*, General Electric Company

**Noise in V-Belt Drive Systems.** *E. P. Carter, J. S. Hurry*, The Gates Rubber Company

**Noise Reduction in Food Waste Disposers.** *T. T. Woodson*, Waste King Corporation

**Analysis and Evaluation of Noise in Household Refrigerators.** *E. A. Baillif, J. P. Laughlin*, Whirlpool Corporation

**Evening Inspection Trips**

### Tuesday, May 27

**Morning Session**

Panel Discussion: "The Need for and the Problems in Developing Standards for Domestic Appliances"

W. A. Lewis, chairman AIEE Standards Committee
H. C. Koenig, Electrical Testing Laboratories, Inc.
L. D. Price, National Electrical Manufacturers Association
G. E. Schall, Underwriters' Laboratories, Inc.
F. E. Hodgdon, American Gas Association, Inc.
Miss Willie May Rogers, Good Housekeeping Institute
F. J. Schlink, Consumer's Research, Inc.

**Lunch 12:30**

**Afternoon Session**

**Electric Controls for Gas Appliances.** *J. A. Deubel*, General Controls Company

**Controlled Cooking—How Far Can We Go.** *H. Levine*, General Electric Company

**A New Look at Engineering Kitchen Appliances.** *H. E. Morrison*, Whirlpool Corporation

**Standardization of Preshipment Testing of Packaged Products through the National Safe Transit Program.** *P. W. Bush*, Westinghouse Electric Corporation

## First Joint Conference on Automatic Techniques

The first Joint Conference on Automatic Techniques, sponsored by AIEE, The American Society of Mechanical Engineers (ASME) and the Institute of Radio Engineers (IRE), is scheduled for April 14-16, 1958, at the Hotel Statler in Detroit, Mich.

The 3-day meeting will emphasize automatic control techniques for raw material processing and manufacturing industries, with strong collateral treatment of computers, data processing, and control components.

Program Committee members include: W. R. Harris, chairman; F. D. Snyder, ASME; G. W. Knapp, AIEE; C. A. Priest, IRE; and A. R. Satullo, Detroit Section.

The tentative technical program for the Conference follows:

### Monday, April 14

**Morning, Session I—Practical Application of Automatic Techniques in the Manufacturing Industries**

**CP58-583 Numerical Control Proves Itself in Production.** *C. M. Rhoades*, General Electric Company

**CP58-584 Semiautomatic Circuit Component Tester.** *F. C. Brammer*, International Business Machines Corporation

**CP58-585 Advanced Automatic Control Applied to Metal Rolling and Processing Electrical Drive Systems.** *E. H. Browning*, Westinghouse Electric Corporation

**Afternoon, Session II—Practical Application of Automatic Techniques in the Process Industries**

**CP* Control Systems Design by Logic: Safety Interlocks and Sequential Controls for Chemical Processes.** *Packard Laird*, E. I. du Pont de Nemours & Co. (Inc.)

**CP58-586 Application of Automatic Techniques in the Handling of Physical Data for a Modern Refinery.** *W. G. Deutsch*

**CP58-587 An Analog Computer as an Active Part of a 200-Hp Automobile Dynamometer.** *G. E. Hindley*, Reliance Electric and Engineering Company

### Tuesday, April 15

**Morning, Session III—Practical Application of Automatic Techniques in Engineering Computations**

**CP* The Application of Computers to Automotive Design annd System Studies.** *J. T. Olsztyn*, General Motors Corporation

**CP58-588 Automatic Engineering through Computers.** *R. W. Ferguson*, Westinghouse Electric Corporation

**CP58-589 Automation in Highway Design.** *J. M. Cahn*, Benson-Lehner Corporation

**CP* Automatic Techniques, Large Computers, and Engineering Computations.** *Dr. V. Paschkis*, department of mechanical engineering, Columbia University

**Afternoon, Session IV—Practical Application of Automatic Techniques in Operational Data Handling**

**CP* A Survey of the Application of Automatic Devices for Electric Power Generation.** *A. C. Hartranft, F. H. Light*, Philadelphia Electric Company

**CP58-590 Data Processing and Control for Steel Mills,** *D. E. Cummings*, Beckman Systems Group

**CP58-591 Automatic Job Control Data System.** *Carl Pilnick*, Consolidated Avionics Corporation

**CP58-592 A Nation-Wide System for Automatic Processing of Business Data.** *W. F. Gregory, W. J. Walsh*, Western Union Telegraph Company

### Wednesday, April 16

**Morning, Session V—Panel Discussion on the Status of the Tools of Automatic Techniques**

Moderator: Frank Lewis, General Electric Company

**CP58-593 The Impact of Available Numerical Control Components on Machine Tool Design.** *H. W. Mergler*, The Warner & Swasey Company

**CP* The Application of the Punch Card to Automatic Weighing of Bulk Material.** *W. B. Young*, Richardson Sale Company

**CP58-594 Process Instrumentation for the Measurement and Control of Level.** *George Revesz*, Robertshaw-Fulton Controls Company

**CP* Basic Gages and Gaging Considerations for Automatic Machine Control.** *J. W. Hopper*, Pratt & Whitney Company

**CP* Industrial Servo Valve Applications.** *R. G. Spencer*, Vickers, Inc.

**Afternoon, Session VI—Inspection Trip**

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*Conference Papers will not be printed by the Institute; however, they may be available at the meeting at the discretion of the author.

## ECPD Publishes 25th Annual Report

With the recent publication of its 1956-57 Annual Report, Engineers' Council for Professional Development (ECPD) marks its 25th year of operation. M. D. Hooven, president of ECPD, and past president of AIEE, comments on the progress of the Council in his report, acknowledging "the tremendous contributions that are made to ECPD, largely in voluntary individual services, but also in terms of money . . . Perhaps the most important support of all, however, is the purely intangible one that is given by the continued co-operation of the entire profession . . . in ECPD operations there has been much less emphasis on organization and procedure than on getting the job done. In its field ECPD has achieved solidarity within the profession."

Following the president's message are reports of each of ECPD's committees, including Guidance, Education and Accreditation, Student Development, Training, Recognition, Ethics, Information, the Committee on EUSEC Conference on Engineering Education and Training, and the ECPD–EJC Joint Committee on the Survey of the Engineering Profession. Statements by representatives of the constituent organizations pertinent to programs of ECPD are also included in the Report, as well as an account of the highlights of the 25th Annual ECPD Meeting, held October 24-25, 1957, at the Hotel Statler in New York, N. Y., and featuring the Silver Anniversary Dinner. A condensation of an address presented by C. E. Davies, first secretary of ECPD, at the Silver Anniversary Dinner is published in the Report, tracing the development of ECPD.

Publications offered by ECPD are described in the Annual Report, which is available at $1 from Engineers' Council for Professional Development, 29 W. 39th St., New York 18, N. Y.

## April 14-15 Is Date Set for Rubber and Plastics Conference

The 9th Conference on Rubber and Plastics will be held April 14-15, 1958, at the Sheraton Mayflower Hotel in Akron, Ohio. This Conference is sponsored by the AIEE Rubber and Plastics Subcommittee of the General Industry Applications Committee.

The tentative technical program for the Conference follows.

### Monday, April 14

**9:00 a.m. Opening Keynote Address**

R. A. Jay, director of engineering, Goodyear Tire & Rubber Company

**9:45 a.m. Morning Session**

**A Static-Magnetic Adjustable Speed Motor Controller.** *D. A. Baker,* Cutler-Hammer, Inc.

**Precision Speed Matching for Calender and Train Drives.** *P. R. Gravenstreter, W. A. Shelton,* Clark Controller Company

**12:00 Noon Luncheon Recess**

**2:30 p.m. Afternoon Session**

**Automatic Bulk Conveying of Plastic Materials with Air.** *A. D. Bloomberg,* Monsanto Chemical Company

**Tread Conveyor System.** *Leo Willmott,* Willmott Electric Company.

**5:30 p.m. Cocktail Hour**

**6:30 p.m. Banquet**

Address: Dr. N. P. Auburn, president University of Akron, "Soviet Higher Education—Threat or Promise"

### Tuesday, April 15

**9:00 a.m. Morning Session**

**Electronic Weighing in Material Handling Applications.** *V. C. Kennedy, Jr.,* Streeter-Amet Company

**An Automated Warehousing Installation.** *R. N. Johnson,* W. F. & John Barnes

**12:00 Noon Luncheon Recess**

**2:30 p.m. Afternoon Session**

**Aids in Trouble Shooting.** *John Sutton,* B. F. Goodrich Company

**3:45 p.m. Subcommittee Reports**

1. **Problems Due to Atmospheric Contamination.** Chairman, *N. A. Williams,* Goodyear Tire & Rubber Company
2. **Standardization for Rubber and Plastics Industries.** Chairman, *W. S. Watkins,* Ohio Rubber Company

## Joint Railroad Conference To Be Held in Cleveland, Ohio

The 1958 Railroad Conference will be held in the Hotel Statler, Cleveland, Ohio, on April 9-10, sponsored jointly by the Railroad Division of The American Society of Mechanical Engineers (ASME) and the Land Transportation Committee of AIEE, with the co-operation of the Cleveland Sections ASME and AIEE. There will be 14 technical papers of interest to those in the railroad field (see box, lower right).

Two special luncheons and a banquet have been arranged with prominent railroad company figures as guest speakers.

The tentative program is as follows:

### Wednesday, April 9

**8:00 a.m. Registration**

**9:00 a.m. Session 1**

Chairman: Random Ferguson, Association of American Railroads
Vice-Chairman: C. A. Itoch, Cleveland Transit System

**58-500. Dollar Damage Done to Diesel Locomotives by Dirt.** *M. B. Adams,* Atcheson, Topeka and Santa Fe Railroad

**CP58-501. Methods of Improving Utilization of Motive Power.** *G. T. Bevan,* General Electric Company

**58-504. An Evaluation of the Effect of Dirt on Diesel-Electric Locomotives.** *J. W. Horine,* Pennsylvania Railroad

**12:00 Noon Social Hour**

**12:30 p.m. Luncheon**

**2:00 p.m. Session 2**

Chairman: K. A. Browne, C & O Railroad
Vice Chairman: Sergei Guins, C & O

**58-505. Field Experience with Electrostatic Precipitation on Diesel Locomotive Engine Air Intake.** *P. Kangas, W. C. Kern,* Baltimore and Ohio Railroad, *E. L. Richardson,* Westinghouse Electric Corporation

**58-507. Railway Traction Equipment Ventilating Systems.** *B. A. Widall,* GE

**(ASME Paper) Improving Rail Adhesion for Diesel Locomotives.** *P. Gorin,* Southern Pacific Railroad

**7:00 p.m. Banquet**

### Thursday, April 10

**8:00 a.m. Registration**

**9:00 a.m. Session 3**

Chairman: H. P. Wright, B & O
Vice-Chairman: J. H. Ray, B & O

**58-502. An Analog Computer Study of a Torsional Vibration Problem.** *S. W. McElhenny,* GE; *R. T. Gray*

**58-503. Wheel Slip Protection.** *C. M. Hines,* Westinghouse Air Brake

**58-RR-3. (ASME Paper) Available and Potential Developments in Design for Standard AAR Solid-Bearing Assemblies.** *M. A. Hanson,* Magnus Metal Corp.

**58-RR-2. (ASME Paper) The Hydrocushion Car.** *W. K. MacCurdy, R. M. Hermes,* Stanford Research Institute

**12:00 Noon Social Hour**

**12:30 p.m. Luncheon**

**2:00 p.m. Session 4**

Chairman: John Ingles, D. T. & I Railroad
Vice-Chairman: E. Crankshaw, Cleveland Graphite Bronze Co.

**58-RR-4. (ASME Paper) Vibration and Shock in Freight Cars as Causes of Lading Damage.** *J. C. Settles,* Buckeye Steel Castings Co.

### Availability of Papers

Only *numbered* ASME papers in this program are available in separate copy form until February 1, 1959. Copies can be obtained from the ASME Order Department, 29 W. 39th St., New York 18, N. Y. Prices are 25¢ to members of ASME, 50¢ to nonmembers. Papers must be ordered by the paper numbers listed in this program otherwise the order will be returned. The final listing of available technical papers will be found in the issue of *Mechanical Engineering* containing an account of the Conference.

AIEE numbered papers can be obtained from Order Dept., AIEE headquarters, 33 W. 39th St., New York 18, N. Y.

**(ASME Paper) Railroading in Canada.** *R. E. Swanson,* Department of Railways, Canada

**58-RR-1. (ASME Paper) Aluminum in Rolling Stock, Impact Tests at Collision Speeds.** *R. A. Campbell, J. G. Sutherland, J. P. Whiting,* Aluminium Company of Canada, *R. A. Kemp*

## 1958 Electronic Components Conference

"Reliable Application of Component Parts" will keynote the 1958 Electronic Components Conference to be held April 22-24 at the Ambassador Hotel, Los Angeles, Calif. The Conference is sponsored by AIEE, Institute of Radio Engineers, Electronic Industries Association, and West Coast Electronic Manufacturers Association, with active participation of the agencies of the Department of Defense, National Bureau of Standards, and industry, in general. The attendance at the 1957 gathering was approximately 650.

Committee officers for the Conference include: Raymond Soward, Convair, Division of General Dynamics, general chairman; J. M. Glass, Hughes Aircraft Co., general vice-chairman; Crosby Kelly, Litton Industries, arrangements chairman; E. E. Brewer, Convair, technical program chairman; D. M. Knox, Packard Bell Electronics, publicity chairman; I. Doshay, Hughes, publications chairman; and G. H. L. Norman, Sprague Electric Co., Pacific Division, finance chairman.

## President Barrett Visits Miami Section

W. J. Barrett, AIEE president, and H. W. Oetinger, vice-president of AIEE District 4, were the guests of the Miami Section of the Institute on January 13, 1958. The visitors toured the beautiful University of Miami campus and President Barrett addressed the Senior Class of the College of Engineering at a special assembly held in his honor. Members of the newly formed Student Branch of the University served as hosts and guides.

The members of the Miami Section had an opportunity to meet President Barrett and Mr. Oetinger that evening at a dinner in the Bahama Room of the Columbus Hotel, Miami. President Barrett addressed the 100 engineers and their wives who had assembled for the meeting. His invitation to "see us in New York in the new national headquarters building" was received with enthusiasm by the Miami engineers.

## National Telemetering Conference, June 2-4, 1958

The Maryland Section of AIEE will be host to the National Telemetering Conference in June 1958. Sponsored by the AIEE, American Rocket Society (ARS), Instrument Society of America (ISA), and Institute of Aeronautical Sciences (IAS), the 1958 National Telemetering Conference will be held June 2-4, at the Lord Baltimore Hotel in Baltimore, Md.

The technical program will include a program on IGY, which deals not only with radio and wired telemetering, but also a new medium of transmission, sonic telemetering. Other papers on telemetering will be presented which cover the general fields of oceanography, astronomy, cosmic ray, and rocket sounding studies.

There will be sessions on the application of transistors to telemetering, r-f receiver design, accuracy analysis, reliability, evaluation of pickups, industrial applications, data reduction, frequency allocation, and telemetering problems in interplanetary vehicles. A security classified session is being planned for June 5, the day following the official closing date of the Conference. Some overseas papers from Switzerland, England, France, and Italy, will be presented.

Next in importance to a strong technical program is the equipment exhibit of the 1958 Conference. Leading manufacturers in the telemetering field will show and demonstrate their latest equipment. This will offer a convenient means of keeping informed on the fast-moving telemetering art.

A number of inspection trips have been planned, one of which is an all-day visit to Aberdeen Proving Grounds, approximately 35 miles from Baltimore. Lunch will be served between discussions on military telemetering.

The evenings have been arranged to please both the men and their wives, with social activities blending old Maryland hospitality with gracious living. Monday will feature fine food with a unique setting; Tuesday evening, there will be a smart Telemetering Banquet with a nationally known speaker. The ladies program will include daily get-togethers, a fashion show, a sightseeing trip, and a visit to the famous McCormick Company—home of spices and teas. So, bring the ladies and they will come away with a memory of Baltimore and Maryland, that will long be remembered.

For further information, contact: E. T. Loane, Attendance Chairman, National Telemetering Conference—1958, % C. & P. Telephone Company of Maryland, 320 St. Paul Place, Baltimore 2, Md.

## Switchgear Committee Reports on its Standardization Activities

Capacitive switching has as broad an interest base as any subject under consideration by the AIEE Switchgear Committee and its Subcommittees. Furthermore, there are so many facets to the problems and products involved that the development of consistent and mutually compatible standards is not a simple task. Nevertheless, several significant steps have recently been taken:

1. A Working Group of the Automatic Circuit Reclosers and Automatic Line Sectionalizer Subcommittee has secured unanimous Subcommittee approval of its proposed new Standard, "Capacitor

## AIEE Virginia Mountain Section

*The Roanoke (Va.) Times Photo*

**O. S. CLARK (*right*), president of the Southwestern Virginia Engineers Club, meets AIEE officers at a joint meeting of the Engineers Club and the Virginia Mountain Section on January 22, 1958, at Roanoke, Va. The Institute officers are: (*left to right*) W. J. Barrett, AIEE president; H. W. Oetinger, AIEE vice-president for District 4; and J. O. Bewley, chairman of the Virginia Mountain Section. President Barrett addressed the groups on the plans for the new United Engineering Center to be erected on United Nations Plaza in New York City. On the evening before the meeting, he addressed the Virginia Polytechnic Institute Student Branch at Blacksburg, Va.**

Switches for A-C Distribution Systems." Letter ballot consideration by the entire Committee is now in process.

2. In the Switches, Fuses, and Insulators Subcommittee, a Working Group has prepared proposed revisions of AIEE Standard No. *22* to cover capacitor switching with interrupter switches. This proposal has been transmitted to other Subcommittees for comment.

3. The Switchgear Committee is now voting by letter ballot on a proposed revision of the Low Voltage Air Circuit Breaker Standards, *C37.13* and *C37.14*, to cover capacitive switching standards.

4. The Power Circuit Breaker Subcommittee has an active Working Group on Standards for Capacitance Switching. During a February Working Group meeting, real progress was made toward defining acceptable line switching performance and reasonable line length requirements.

It may be desirable to report here that the Switchgear Assemblies Subcommittee still desires comments on its "Guide for Evaluating the Effects of Solar Radiation on Outdoor Metal-Clad Switchgear." The trial use period on this guide, report No. *955*, has been extended to at least May 15, 1958.

No switchgear activities report is complete without some mention of the tremendous effort and steady progress of the 20-man Working Group on Method of Rating Power Circuit Breakers. During a 2-day meeting in mid February, careful consideration was given by the entire Working Group to extensive reports by its three task forces on Rating, Test Code, and Application Guide respectively.

C. A. Woodrow is chairman of the Switchgear Committee, J. H. Vivian is vice-chairman, and F. W. McCloska is secretary.

## Maine Section Demonstrates Excellent Attendance Record

The Maine Section of AIEE, with 98 National members as of August 1, 1957, has problems in serving its members quite different from those of many other Sections. The area covered by the Maine Section includes the entire state of 30,000 square miles. Its members are located from Kittery to Limestone, a distance of 350 miles.

The majority of the members may be considered in one of three geographical areas: Portland, Augusta, or Bangor; however, there are 133 miles between Portland and Bangor, with Augusta 57 miles from Portland and 76 miles from Bangor.

The Section tries to overcome this obstacle of distance by holding at least one of the monthly Section meetings during the year in each of the principal areas with other meetings at in-between points. The monthly meetings, usually three in the Fall and three in the Spring, timed to avoid the unpredictable and possibly difficult driving conditions during midwinter, include an evening meal and a speaker. Several of the members travel up to 150 miles one way specifically to attend these meetings, and usually at least 10 or 12 members present at any one meeting will have traveled 60 miles one way to attend. National member attendance at these monthly meetings is about 33% and the Section is especially proud of it considering the distances traveled by the members. The total attendance at the meetings has averaged 86 over the last year and one half.

In addition to the monthly Section meetings which help to hold the members throughout the State together as a unit, there are technical group meetings which are very popular. The technical group by its very nature and intent fits well into Sections conditions. These meetings are held as informal sessions usually in the evening, not including a meal, with a program designed to be of interest to the members in an immediate area. As an example, the members in the Augusta area are predominantly interested in power and utility problems and have formed the very active Augusta Power Group with 12 meetings during the one and one-half years just passed. At these meetings, the average national member attendance is 13, with an average total attendance of 25. Even at these meetings, it is not uncommon to have one or more members travel 60 miles one way to attend.

A group located in the Bangor area and interested particularly in pulp and paper has held one meeting and is planning future ones.

Members are working toward an area group in Portland which will cover the specialized interest there.

The big event for the year is an afternoon and evening meeting and ladies' day held at one of Maine's famous summer resorts. The afternoon is taken up with technical sessions for the men; tours and talks for the ladies. The evening includes a social hour, dinner, and a speaker. These meetings are always very successful with 125 to 150 total attendance.

In conclusion, the Maine Section is attempting to serve its scattered membership by means of localized technical group meetings, and yet maintain a co-ordinated program throughout the State with the aid of the regular monthly meetings.

## NAS–NRC To Co-ordinate NBS Advisory Committee Program

The National Bureau of Standards (NBS) and the National Academy of Sciences–National Research Council (NAS–NRC) have announced an expanded plan for co-ordination of the NBS technical advisory committee program by the NAS–NRC in co-operation with a number of the major professional scientific societies of the United States.

NBS, one of the Government's major scientific research laboratories, is responsible for maintenance and development of the national standards of measurement and conducts extensive basic research in physics, chemistry, mathematics, and engineering.

The NAS–NRC is a non-Government organization of the nation's leading research scientists dedicated to the furtherance of science and its use for the common welfare. It is specifically authorized by Act of Congress to advise the Federal Government, upon request, on matters of a scientific or technical nature.

The NBS advisory committee program grew out of the recommendations of a committee appointed by the Secretary of Commerce in 1953. Since that time, advisory committees appointed by various professional scientific societies have helped to keep the NBS informed of the needs of the nation's scientific and technological community and have evaluated the NBS work in areas of interest to their professions. At the same time, they have provided an effective link whereby the scientists and engineers of the country have gained increased awareness of the scientific contributions and services available from the NBS.

The new plan for co-ordination of these advisory activities by the NAS–NRC will strengthen the current program by allowing more complete coverage of the NBS diversified research activities, and by providing for the co-ordination of recommendations from the various professional interests which the NBS serves.

Under the new arrangement, the scientific societies will nominate representatives from among their membership to serve as advisors to the NBS. From the base provided by these society delegations the NAS–NRC will assemble a number of advisory panels, each of which will have responsibility for evaluating a particular segment of NBS work. Thus, certain NBS activities, such as building technology which does not fall within the scope of any one professional society, can now be served by advisory panels staffed from various societies. The panels will report at least once a year on the status of NBS activities under their cognizance. These reports will form the basis for an integrated annual report by the NAS–NRC to the NBS.

Initial nominations of advisory representatives will be made from the following societies: AIEE, American Chemical Society, American Institute of Physics, Institute of Radio Engineers, American Ceramic Society, American Institute of Mining, Metallurgical and Petroleum Engineers, American Society of Mechanical Engineers, and American Society of Civil Engineers. The Policy Committee for Mathematics will nominate individuals from the various professional mathematics societies.

## Additional Conference Papers Are Now Available

The following is a list of conference papers presented at the 1958 AIEE Winter General Meeting, February 3-7, which were not numbered at the time of the meeting. They have now been numbered and are available to members for 40¢ and to nonmembers for 80¢. Send order and remittance to AIEE Order Department, 33 W. 39th St., New York 18, N. Y.

CP58-251 345-Kv Power Cable Research: An Example of University and Industry Co-operative Research. Report of AEIC–EEI Steering Committee for the Project. Presented by *L. I. Komives*

CP58-253 Preliminary Report of Feedback Control Systems Subcommittee on Component Specifications. *D. D. Pidhayny*, chairman
255 Thermal Life of Enameled Magnet Wire. Report by Working Group on Enamel Magnet Wire, Dielectrics Committee. *J. F. Dexter*, chairman
256 Technical Education in England. *Denys Akhurst*
257 Dial Selected Industrial Television for Ticket Reservation Facilities. *J. W. Alinsky*
433 Recent Study on Higher Secondary Voltage Systems for Residential Service. *A. S. Anderson*
258 Higher Secondary Voltage for Residential Service. *A. S. Anderson, Chase Hutchinson, S. J. Pearson*
259 Magnetic Fields around a Transmission Line Tower. *J. G. Anderson, J. H. Hagenguth*
260 Practical Thermoelectric Power Generation. *S. J. Angello*
261 Reliability of Transformers for Electronic Applications. *O. L. Angevine*
262 Power Systems for Small Plants Served at above 15 Kv. *D. B. Armstrong, L. H. Greutzmacher*
263 A New Design of Low-Voltage Power Circuit Breaker with a Constant-Energy Closing Mechanism. *L. L, Baird, R. J. Baskerville*
264 A Static Annunciator System. *W. H. Baker, E. A. Sagan*
266 Pretied Tie for Communication Line Wires. *C. R. Ballard, R. R. Bouche*
267 Engineering for Off-the-Air Television Service in Southern California. *E. D. Barcus*
268 Accuracy Limitations of Geared Up Encoder. *W. Barr, W. I. Frank*
269 The Radiation Effects Information Center. *H. R. Batchelder, C. J. Lyons*
270 Inductrol D-C Drives. *Max Berman*
271 Role of the MIT Computing Center in Visual Tracking of Earth Satellite. *J. F. Blackburn*
272 Advancements in the Facsimile Art during 1957. *W. H. Bliss*
273 Teledata System. *E. O. Blodgett*
274 The Application of Electrode Positioning Controls for Vacuum Arc Melting Furnaces. *E. J. Borrebach*
275 The Effect of Varying the Electrode Curvature in Testing the Thermal Flex Life of Insulating Varnishes. *R. L. Bowman*
276 Transistor Phase Locked Oscillator. *D. J. Brady, K. A. Edwards, O. Golubjatnikov*
277 Recent Advances in Control Systems for Continuous Processing Lines. *C. P. Brooks, J. T. Bradford*
278 Water Cooling of Generator Stator Windings. *G. V. Browning, J. F. Quinlan, C. H. Holley*
281 The Application Static Switching Techniques to Programming Control. *M. W. Cannon, K. R. Thompson*
282 Electron Tube Evaluation for Guided Missile Applications. *H. G. Chandler*
339 Glass Flake in Electrical Insulation. *L. M. Conklin, M. P. Koerner, Jr.*
286 A User's Experience with Rectifier Transformer Failures. *E. H. Coxe, H. O. Bourque*
288 Effect of In-Pile Radiation on Ceramic Triod. *J. R. Crittenden*
289 Effects of Gamma Radiation on Silicone Dielectrics. *C. E. Currin*
290 The Effects of Gamma Radiation at High Temperatures on the Engineering Properties of Elastomer Materials. *P. W. Davis*
294 A 1,000-Mva, 13.8-Kv Magnetic Deion Air Circuit Breaker. *R. C. Dickinson, Russell Frink*
296 A New Industrial TV Camera System. *J. E. Dilley, G. A. Senior*
297 Microwave Protective Relaying Facilities in the Cleveland Electric Illuminating Company. *E. W. Downer*
300 Synchronizing Clock for Data Transmission. *J. O. Edson, M. A. Flavin, A. D. Perry*
CP58-301 Unusual Applications of Closed-Circuit Television. *C. L. Ellis*
304 Recent Advances in Busway Concepts. *C. J. Falk, C. A. Brown*
305 The St. Lawrence River High-Voltage Submarine Cable Crossing—Part II, Experimental Program and Cable Manufacture. *D. M. Farnham, G. B. Shanklin, S. H. Cunha, H. D. Short*
306 Relative Shock Hazard. *W. B. Kouwenhoven*
307 Safety Considerations in Air-Conditioning Equipment Symposium on Higher Utilization Voltages, AIEE Committee on Safety, *G. S. Jones, Jr.*
307A Symposium on Safety Considerations in the Proposed Use of Higher Secondary and Utilization Voltages. *A. E. Pringle*, Symposium moderator
309 Power Distribution at Vancoram Plant, Vanadium Corporation of America. *F. G. Fellows, H. F. White*
310 Recent Progress in Applying Information Theory to Digital Transmission Systems. *R. F. J. Filipowsky*
311 Insuldur—Another Milestone in Transformer Insulation Development. *J. G. Ford, J. Swiss, G. C. Gainer, M. G. Leonard*
312 Why Not Use Sine-Cosine Encoder. *W. I. Frank*
317 The Aims and Activities of the Engineering Foundation. *E. I. Green*
321 Recorded Carrier System. *R. M. Gryb*
322 A Versatile New Acetal Resin for Engineering Use. *E. F. Hamilton, Jr.*
323 A New Output Printer-Whippet. *G. Harris, H. Epstein*
324 Alternate Methods of Tying with Utilities. *T. W. Haymes, R. B. Thompson*
CP58-325 A Unit for Checking A-C Indicating Instruments. *H. N. Haywood*
326 Properties of Octofluorocyclobutane—A Dielectric Gas. *F. B. Hill*
327 Static Electricity in the Petroleum Industry. *J. C. Howard*
328 Motor Field Control for Large Reversing Mill Motors. *L. R. Hulls*
329 Effective Voltage on Cable Jackets and Analysis. *G. H. Hunt*
331 Conductivity Induced in Insulating Materials during Gamma Irradiation. *G. C. Huth*
331 Resistance Measurements of Deep Driven Grounds. *C. H. Jensen*
343 Field Strength Measurements in Parallel Plate Precipitators. *J. S. Lagarias*
346 Laboratory and Field Testing on Silicon Diode Rectifiers for Electrical Precipitation Service. *H. D. Laube, L. J. Theriault*
347 New Class F Wire Enamel-Varnish Systems. *J. R. Learn, R. B. Young*
351 Thermoelectric Heat Pumping—A Survey. *N. E. Lindenblad*
352 Automatic Precipitator Control. *L. L. Little*
353 A New High-Temperature Perfluorocarbon Resin for Conventional Thermoplastic Processing. *R. S. Lovett, Miles Powell, Jr.*
355 The Application of Computers to Problems of Transportation Equipment Design. *D. R. MacLeod*
357 Technical Education in India. *M. G. Malti*
358 A New Method of Corona Suppression for High-Voltage Rotating Machines. *V. E. Manni, William Schneider*
360 Magnetic Properties of ACSR Core Wire. *L. W. Matsch, W. A. Lewis*
361 Evaluation of Control Grid Current in Radio Tubes. *L. T. May*
363 Wiring a Town for Closed-Circuit Movie Distribution. *H. J. McMains*
364 Further Considerations on Reduced Transformer Insulation Levels. *J. R. Meador*

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# AIEE Fellow Honored

**AIEE Fellow credentials are presented to Prof. C. F. Dalziel (right), University of California and chairman, San Francisco Section, by W. C. Smith (F '40) at January General Section Meeting. With the faculty on the Berkeley campus since 1932, Prof. Dalziel has been active professionally as consulting engineer, electrical expert, and expert witness. Mr. Smith, a retired General Electric engineer, was San Francisco Section chairman 1933–34. Also to have received Fellow credentials at the January General Meeting was G. C. Tenney, vice-president, McGraw-Hill Publishing Co., Inc.**

# Conference Papers Open for Discussion

Conference papers listed below have been accepted for AIEE *Transactions* and are now open for written discussion until April 25. Duplicate double-spaced typewritten copies of each discussion should be sent to E. C. Day, Assistant Secretary for Technical Papers, American Institute of Electrical Engineers, 33 West 39th St., New York 18, N. Y., on or before April 25.

**57-669** **Television Systems for In-School Teaching.** *M. H. Kraus*
**57-914** **Willamette Valley Radio System for the U.S. Corps of Engineers.** *C. Pedersen, D. J. Marihart*
**57-1016** **Transistorized Negative Impedance Telephone Repeaters.** *R. P. Dimmer*
**57-1034** **Stability Study of a Third-Order Servomechanism with Multiplicative Feedback Control.** *Y. H. Ku, C. F. Chen*
**57-1096** **Technical Aspects of Providing Service to Single-Phase 60-Cycle Railroad Loads.** *T. J. Nagel, A. F. Gabrielle*
**58-231** **Function Tables in Digital Control Computers.** *E. J. Schubert*
**58-240** **General Analysis and Stability Study of Finite Pulsed Feedback Systems.** *G. Farmanfarma*

Reprints may be purchased at 40¢ each to members, 80¢ each to nonmembers, if accompanied by remittance or coupons. Please order by number and send remittance to: AIEE Order Department, 33 West 39th St., New York 18, N. Y.

**Membership in the American Institute of Electrical Engineers, including a subscription to this publication, is open to most electrical engineers. Complete information as to the membership grades, qualifications, and fees may be obtained from Mr. N. S. Hibshman, Secretary, 33 West 39th Street, New York 18, N. Y.**

CP58-365 A Photoelectric Analog-to-Digital Converter Using a Complementary Code Pattern. *B. D. Merrill, R. Mugni*
366 Computer Design of Small Electronic Transformers. *Wade Etchison, M. B. Meunier, Reuben Lee*
367 Magnetic Field Strength in Oersteds Near Large Rectangular Conductors. *J. H. Miller*
370 An Analog Frequency Measuring Circuit Accurate to 0.1%. *Jonathan Mitchell*
371 Trip Report on Rectifier Developments in Russia. *L. W. Morton*
446 Progress Report on Thermal Endurance Studies of High-Voltage Insulation Systems for Large Generators. *G. L. Moses, J. C. Botts, R. D. Wolford*
372 Tracking of Earth Satellites at the Vanguard Computing Center. *A. R. Mowle*
373 Analysis and Design of a Transistor Linear Delay Circuit. *R. P. Nanavati*
374 Design Considerations for Miniature Automatic Null-Balancing Electrical Measuring Instruments. *D. A. Narducci, Jr.*
375 Field Failure Analysis and Its Effect on Electron Tube Reliability. *N. E. Nitschke*
376 Present Status of Facsimile in Japan. *Yasujiro Niwa*
378 Improved D-C High-Potential Testing of Insulation Systems in Low- and Medium-Voltage D-C Equipment. *A. M. Odok, T. M. Soelaiman*
379 A Rugged, Tunable, Thermally Stable X-Band Beacon Magnetron. *C. J. Orlebeke*
381 Collector Response Time from Characteristic Curves. *J. E. Palmer, J. E. Lindsay*
383 Factors Affecting the Use of Over-the-Horizon Links in Telecommunication Networks. *C. A. Parry*
384 Vanguard Satellite Launching Vehicle. *D. D. Pasik, E. E. Loft, W. A. Elfers*
444 Virginian Railway Motor Generator Electric Locomotive Maintenance Costs. *T. F. Perkinson*
386 Dial Switching of Toll Circuits in Independent Telephone Company Areas—Transmission Considerations from the DDD Standpoint. *J. N. Petrie*
389 A Comparative Study of the Radio Influence Characteristics of Several High-Voltage Transmission Lines. *W. S. Price, C. Concordia, G. E. Adams*
CP58-391 Progress in Development of Recommended Practices for Resistance Welding. *R. P. C. Rasmusen*
393 Signaling Systems for Dialing and Supervision on Overseas Radiotelephone Systems. *C. W. Lucek, J. P. Thornton, E. W. Reeve*
394 Large Heat Pumps. *H. E. Rex*
395 The Challenging Aspects of Electric Space Heating. *W. T. Richards*
330 Acrylic Resin Insulation. *P. F. Sanders, V. R. Huntsberger, R. R. Storrow*
401 The Evaluation of Enameled Magnet Wire. *H. L. Saums, W. W. Pendelton*
403 Lightning Current Distribution in Towers and Ground Wires. *A. J. Schultz, I. B. Johnson, W. S. Price*
404 Lead–Acid Storage Batteries in Telephone Service. *R. C. Shair*
443 The *83B1* Teletypewriter Selective Calling System. *C. W. Smith, C. J. Votaw, A. L. Whitman*
407 SAGE Data Terminals. *R. O. Soffel, E. G. Spack*
409 Experience in Computation of Load Flow Studies Using High-Speed Computer. *H. P. St. Clair, G. W. Stagg*
CP58-412 A Digital Computer Program for Multiple Unit Train Performance Calculations. *R. E. Stillwagon, C. P. Saalback*
413 A Planned Large High-Voltage Germanium Rectifier Installation. *R. P Stratford, H. N. Hickok, George Choma*
415 Improvement of Electron Tube Quality through Receiving Inspection and Failure Analysis. *M. Swadow*
417 Some Applications of a New Approach to Loss Minimization in Electrical Utility Systems. *T. W. Sze, Jr., J. R. Garnett, J. F. Calvert*
421 A Medium Size Anechoic Chamber. *T. J. Twomey*
423 Transistor Bias Design from Thermal Incremental Properties. *L. M. Vallese*
425 Evaluation of Single-Phase Metering Practices Based on Meter Performance and Load Characteristics. *J. M. Vanderleck*
427 Design Concepts in the Development of Bolted Aluminum Power Connectors. *J. R. Warren*
428 The Role of Customer–Vendor Agreements in the Maintenance of Electron Tube Quality Levels. *A. Warsher, A. J. Heitmer*
430 FM Digital Subset. *L. A. Weber*
431 Compound Air Source Heat Pump. *R. G. Werden*
432 Kemano–Kitimat 300-Kv Cross Suspension System. *H. B. White*
441 Report of the Working Group on Revision of ASA C-34 Standards. *H. Winograd*
437 Generalized Recurrence Relations in the Analysis of Physical Nonlinear Systems. *A. A. Wolf*
439 STRAD—A New concept for a Fully Electronic Automatic Signal Sorting and Distribution System. *E. P. G. Wright*
440 A-C Network Analyzer Studies of Interconnected Utility and Industrial Power Systems. *C. C. Young, J. Dunki-Jacobs*

# AIEE PERSONALITIES

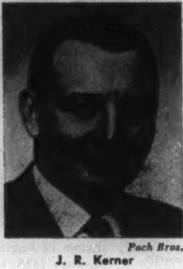
## Nominated for Institute President

**L. F. Hickernell** (AM '25, F '34), vice-president, engineering, Anaconda Wire & Cable Company, Hastings on Hudson, N. Y., has been nominated for the office of 1958-59 president of the AIEE. Mr. Hickernell was born in Middletown, Pa., March 22, 1899. He received the B.A. degree from Grinnell College in 1920, and the B.S. degree in E.E. from Massachusetts Institute of Technology in 1922. Upon graduation, he joined the General Electric Company in Lynn, Mass., as a graduate student engineer. In 1923, he entered the engineering department of Consumers Power Co., Jackson, Mich., and continued to work for this firm's successors, Commonwealth Power Corp., Stevens & Wood, Inc., and Allied Engineers, Inc., until 1931. During this period, he held the positions of assistant investigations engineer and general engineer. He joined Anaconda Wire & Cable Company in 1931 as electrical engineer. He was named chief engineer in 1933 and vice-president, engineering, in 1957. Mr. Hickernell has been active in several organizations including National Electric Light Association, Insulated Power Cable Engineers Association, National Electrical Manufacturers Association, American Society for Testing Materials, American Transit Association, and Conference Internationale Des Grands Reseaux Electriques. He is also a member of the Institution of Electrical Engineers

*Blackstone Studios*

**L. F. Hickernell**

**L. C. Holmes**


*Pach Bros.*

**J. R. Kerner**

**R. B. Gear**

(British), and Engineers' Club of New York City. During his long association with the AIEE, Mr. Hickernell has had a wide range of experience in Institute affairs. He has served as a member and in various officerships in both the Detroit–Ann Arbor (now Michigan) Section and the New York Section. On the national level, his early technical assignments included chairmanships of several subcommittees of the Electrical Machinery, Protective Devices, and Power Transmission and Distribution Committees. When the technical activities were expanded in 1947, he was appointed chairman of the newly created Insulated Conductors Committee, and initiated the very active subcommittee organization which distinguishes that Committee. Mr. Hickernell's general committee functions have included vice-chairman of the Board of Examiners, chairman of the Power Division, and Technical Operations Committees. His memberships have included the Publication, Standards, Public Relations, and Edison Medal Committees. He served four years as a director. During the past three years, he has been the Board member appointed each year to serve as chairman of the Planning and Co-ordination Committee. He was requested to serve this unusually long term in order to handle an important series of surveys and organization studies. At present, he is the Institute's treasurer, a member of the Executive Committee of the Board of Directors, and represents AIEE on the Board of Directors of Engineers Joint Council.

## Nominated for Institute Vice-Presidents

**L. C. Holmes** (AM '31, F '51), research director, Stromberg-Carlson Company, Rochester, N. Y., has been nominated for the office of AIEE vice-president for District No. 1. Mr. Holmes attended Rensselaer Polytechnic Institute where he received his E.E. degree in 1925 and M.E.E. degree in 1932. From 1925 to 1943, he was a member of the engineering faculty at Rensselaer and he served as counselor to the AIEE Student Branch for approximately 7 years. Mr. Holmes joined the Stromberg-Carlson Company in 1943 as senior engineer in charge of sound recording research. He was appointed associate director of research in April 1950, and was advanced to director of research later that same year. As a research scientist, he has made a number of significant contributions in the field of magnetic recording. He has, for several years, represented the Stromberg-Carlson Division of General Dynamics Corporation in the American Society for Engineering Education and the Industrial Research Institute. Mr. Holmes is a registered professional engineer in the State of New York. He is a member of Sigma Xi, Acoustical Society of America, Rochester Engineering Society, and a fellow of the Institute of Radio Engineers. He has served on committees of the Electronics Industry Association and the National Association of Manufacturers, and has been active in civic affairs. Mr. Holmes has served in all the offices of the Rochester Section of the Institute including treasurer, vice-chairman and secretary, chairman, and is presently an ex officio member of the Executive Committee. He is currently serving as secretary-treasurer of AIEE District No. 1. Mr. Holmes has served on the following AIEE Committees: Communication (1947-49), Special Communication Applications (1949-52), and was liaison representative on Standards Committee (1953-54).

**J. R. Kerner** (AM '40, M '54), distribution apparatus manager, Westinghouse Electric Corporation, New York, N. Y., has been nominated for the office of AIEE vice-president for District No. 3. Born in Columbia, Pa., on April 2, 1904, Mr. Kerner joined Westinghouse Electric Corporation at East Pittsburgh, Pa., on the Graduate Student Training Program in July 1923 following his graduation from Bliss Electrical School at Washington, D.C., and has been continuously associated with the corporation since that time. Upon completion of the Graduate Student Course, he was located in the Buffalo, N. Y., District office where he was engaged in sales and engineering work with electric utilities and distributors in the Western New York area for more than three years. Following this, he was transferred to headquarters application work on steam equipment and transformers at Westinghouse plants in south Philadelphia and Sharon, Pa. From 1929 until 1953, he was assigned to the Eastern District of the Corporation. In 1953, he was appointed manager, distribution apparatus for the Northeastern Region with responsibility for the distribution of the company's distribution apparatus products to electric utilities in New York, New Jersey, and the New England States. He has been active in the affairs of the New York Section since 1940, serving on many committees of the Section and its Power and Industrial Division. He was chairman of the New York Section in 1954-55 and has been a member of its Advisory Committee since that time. He was chairman of the General Session Committee for the 1955 Winter General Meeting and has been a member of other committees for subsequent Winter Meetings. At present, he is serving as secretary of District No. 3. He has been a member of the AIEE Sections Committee since 1955, serving as chairman of the Subcommittee on Section Growth Award since that time and is currently Interim Chairman of the Sections Committee group studying Section finances. Mr. Kerner is also a member of the American Society of Mechanical Engineers and of the Engineers Club of New York.

**R. B. Gear** (AM '30, F '55), director of purchases, Commonwealth Edison Company, Chicago, Ill., has been nominated for the office of AIEE vice-president for District No. 5. Mr. Gear, born in Chicago, Ill., in 1904, graduated from Cornell University with an E.E. degree in 1928. After graduation, he joined the Commonwealth Edison Company student training course. thereafter being assigned to the distribution engineering department, on 4-kv and industrial service work. In 1936, he became field engineer on generating station engineering, supervising work in large distributing stations, 66-kv terminals and generating station switchhouses. From 1941 through 1945, he served with U. S. Army, Corps of Engineers, on staffs of Second Army, Allied Force Headquarters, Office, Chief of Engineers, and Headquarters Army Service Forces, attaining rank of Colonel in 1944. Returning to Edison Company, he progressed to section engineer, station engineering department, in charge of generating station electrical design for certain units. On establishment of the Nuclear Power Study Group in 1951, he became technical director and later manager. After a short time as staff assistant to the executive vice-president, Mr. Gear was transferred in 1953 to purchasing activities, becoming director of purchases in June 1954, with responsibilities for buying, traffic, stores, and inventory control functions. Mr. Gear is a registered professional engineer and has served as a director of the Illinois Engineering Council, 1952-55. He is a past chairman of the Chicago Section of AIEE, 1955-56, and has served on many Chicago Section committees. He has served on the following national activities: member ASA C-57 Subcommittee on Current Limiting Reactors, 1949-53; member Exhibits Committee, National Electronics Conference, 1949-50; member Performance Characteristics Subcommittee–Revision of Reactor Standards Working Group, 1953-54; AIEE Representative on Marston Medal Award Board, 1956-58; District No. 5, Executive Committee member, 1955-56.

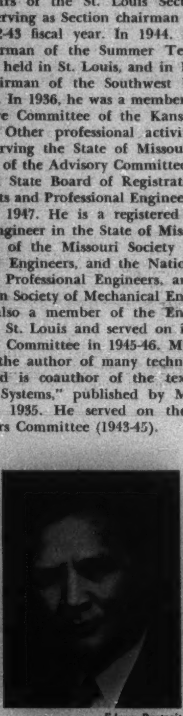
**I. T. Monseth** (AM '26, F '45), Southwestern Region engineering and service manager, Westinghouse Electric Corporation, St. Louis, Mo., has been nominated for the office of AIEE vice-president for District No. 7. A native of Minnesota, Mr. Monseth is a graduate of the University of Minnesota where he received the B. S. degree in E.E. in 1924. From 1929 to 1940, he was employed by Westinghouse as electric utility district engineer and then engineering manager. In 1940, he was appointed to his present position as Southwestern Region engineering and service manager. For his outstanding work, the company awarded him its highest honor, the Westinghouse Order of Merit, in 1939. Mr. Monseth has been active in the affairs of the St. Louis Section of AIEE, serving as Section chairman during the 1942-43 fiscal year. In 1944, he was vice-chairman of the Summer Technical Meeting held in St. Louis, and in 1952 he was chairman of the Southwest District Meeting. In 1936, he was a member of the Executive Committee of the Kansas City Section. Other professional activities include serving the State of Missouri as a member of the Advisory Committee to the Missouri State Board of Registration for Architects and Professional Engineers from 1943 to 1947. He is a registered professional engineer in the State of Missouri, a member of the Missouri Society of Professional Engineers, and the National Society of Professional Engineers, and The American Society of Mechanical Engineers. He is also a member of the Engineer's Club of St. Louis and served on its Educational Committee in 1945-46. Mr. Monseth is the author of many technical papers and is coauthor of the text book "Relay Systems," published by McGraw-Hill in 1935. He served on the AIEE Transfers Committee (1943-45).

**J. M. Nelson** (AM '43, M '49), executive assistant superintendent of Seattle City Light, Seattle, Wash., has been nominated for the office of AIEE vice-president for District No. 9. Mr. Nelson was born in Seattle and graduated from the University of Washington with a degree in electrical engineering. He is a licensed professional engineer in the State of Washington. Mr. Nelson started his career at Seattle City Light in 1936 as an operator's helper. He earned promotions through various grades to the responsible position of senior engineer, and in December 1948 was appointed assistant superintendent in charge of engineering and operations. In January 1955, he was appointed by superintendent P. J. Raver to his present position of executive assistant superintendent. Mr. Nelson is former chairman of the Seattle Section of the AIEE, and past president of the Electric Club of Washington. At the present time, he is a member of and former chairman of the advisory committee set up by the 12 public and private power utilities who will purchase power from the Priest Rapids Project being built by Grant County Public Utility District. He is also quite active in church work.

**W. H. Chase** (M '42, F '51), vice-president, Ohio Bell Telephone Company, Cleveland, Ohio, has been nominated for the office of AIEE vice-president for District No. 11. Mr. Chase, who was born on January 25, 1898, attended Case Institute of Technology and received his B.S. degree from Harvard School of Engineering. He began his Bell System career with the Ohio Bell Telephone Company in 1919. He then was employed by the Hiram Telephone Company and the Home, Pacific, and New England Telephone & Telegraph Companies before returning to Ohio Bell in 1925. After holding various positions, including district commercial manager, division commercial superintendent, general commercial training supervisor, coordination engineer, and building and equipment engineer he was named chief engineer in 1945, assistant vice-president in 1950, and vice-president in 1954. A registered professional engineer, Mr. Chase is past president and a member of the Board of Governors of the Cleveland Engineering Society, and past president and a member of the Advisory Committee of the Cleveland Technical Societies Council. He is a member of many other organizations including American Ordnance Association, U. S. Coast Guard Auxiliary, National Society of Professional Engineers, Armed Forces Communication Association, Cleveland Automobile Club, Cleveland Chamber of Commerce and a senior member of the Institute of Radio Engineers. He is a member of the Co-ordinating Committee of Engineers Joint Council and is serving as chairman of the Development Committee for the Cleveland Engineering and Scientific Center. Mr. Chase is serving on the AIEE Management Committee (1954-58), Lamme Medal Committee (1956-59), and Administration Department (1957-58).

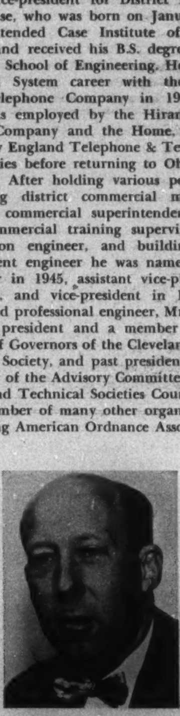
### Nominated for Institute Directorships

**W. A. Lewis** (AM '27, F '45), research professor of electrical power systems engineering, Illinois Institute of Technology, Chicago, Ill., has been nominated to serve on the Board of Directors of the AIEE. Prof. Lewis was born in Harriman, Tenn., in 1904, but moved at an early age to California. His first engineering experience was obtained in the Los Angeles shops of the Westinghouse Electric and Manufacturing Company, now the Westinghouse Electric Corporation. Winning a Westinghouse War Memorial Scholarship, he attended California Institute of Technology, and obtained the degree of B.S. in E.E. in 1926, M.S. in E.E. in 1927, Ph.D. (summa cum laude) in 1929. He returned to Westinghouse in the central station engineering department and spent 10 years in development, application, and consulting engineering relating to the problems of electrical utilities. He also was active in teaching in the Pitt–Westinghouse Graduate Training Program at the University of Pittsburgh. In 1939, he was appointed director of the School of Electrical Engineering at Cornell University. He joined Illinois Institute of Technology in 1944 as consultant in electrical engineering. In September 1946, he was appointed dean of the Graduate School, a position he held until October 1955. At that time he was appointed to a sponsored professorship of electric power systems engineering. Prof. Lewis is a registered professional engineer and a member of the Institute of Radio Engineers, Western Society of Engineers, American Society for Engineering Education, Tau Beta Pi, Eta Kappa Nu, and a fellow of the American Associ-

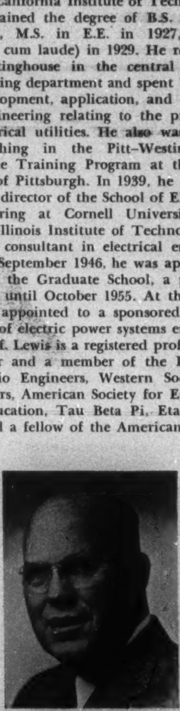


*Edwyn Portrait*

I. T. Monseth



J. M. Nelson



W. H. Chase

W. A. Lewis

N. F. Rode

E. C. Starr

ation for the Advancement of Science. He has been very active in the Chicago Section of AIEE. Prof. Lewis has served on numerous national AIEE Committees including: Protective Devices, Education, Basic Sciences (chairman 1941-42), Power Transmission and Distribution, Standards (chairman 1957-58), Research (chairman 1943-45), Award of Institute Prizes, Relays, Power Division, Rotating Machinery, Switchgear, Planning and Co-ordination, and Technical Operations. He was chairman of the Professional Development and Recognition Department (1956-57).

**N. F. Rode** (AM '22 F '43), professor of electrical engineering, A&M College of Texas, has been nominated to serve on the Board of Directors of AIEE. Mr. Rode was born in Charleston, S. C., in 1898, and received his B.S. degree in E.E. and M.E. from Clemson College in 1919. He has worked for the General Electric, the Chickasaw Shipbuilding, the Isthmian Steamship, and the Sinclair Oil Companies. Since 1922, he has been a member of the teaching staff of the electrical engineering department at Texas A&M College, except for a two-year period of service in the U. S. Naval Reserve as a Lieutenant Commander teaching electrical engineering at the U. S. Naval Academy. He has been active in the Institute since his student days at Clemson College, having served as chairman of the Houston Section, chairman of Technical Papers Committee for the District No. 7 Meeting in Houston, student counselor at Texas A&M for many years, and chairman of the student counselors of District No. 7. He has done consulting engineering in transmission, distribution, and power plant fields. He is a member of Eta Kappa Nu, Phi Kappa Phi, and Tau Beta Pi, a veteran of both world wars and a Commander in the U. S. Naval Reserve. Mr. Rode is a registered professional engineer and holds advanced degrees from Texas A&M and Clemson College. He has been an active member of the ASEE, serving as president of the Texas A&M chapter, and elected member to the National Council from the Southwest Section, and a member of the B. J. Lamme Award Committee of that society. He is also a member of the American Society of University Professors and has been president of the Texas A&M chapter. As a research engineer with the Engineering Experiment Station of Texas A&M College, he has directed the work on analogue computers. Mr. Rode is the present vice-president of District No. 7 of the AIEE.

**E. C. Starr** (M '29, F '41), chief engineer, Bonneville Power Administration, Portland, Ore., has been nominated to serve on the AIEE Board of Directors. Mr. Starr was born in Falls City, Ore. He received a B.S. degree in E.E., and later the professional degree of electrical engineer. After college, he was employed by the General Electric (GE) Company in Schenectady, N. Y. Following this company's test course, he became a member of the GE high voltage engineering laboratory staff in Pittsfield, Mass., where he worked on many phases of high voltage phenomena. Mr. Starr became an instructor of electric engineering at Oregon State College in 1927, a full professor in 1939, and continued his work on the electrical engineering staff until 1954, when he was appointed chief engineer for the Bonneville Power Administration (BPA). In World War II, when on leave from the college, Mr. Starr served as co-ordinator of Aircraft Precipitation Static Research, National Defense Research Committee, Office of Scientific Research and Development. During his tenure at Oregon State College, he served as part-time consulting engineer to BPA from July 1939 to July 1954. He has also served as a consultant to the Reactor Development Division, Atomic Energy Commission (AEC), on industrial power, since 1953. As a civilian scientific observer, he attended the Bikini atomic bomb tests, Operation Crossroads, June to July 1946. He has pioneered in many fields of high voltage transmission including research and development of series and shunt capacitor applications and tests, generator characteristics, circuit breaker advances, and high voltage transformer and cable problems. In his work with the AEC, he has been particularly interested in applications of nuclear fission to the generation of electrical energy. He has won several prizes for papers in the high voltage field and aircraft radio interference. As the author of many technical articles and experiment station bulletins, Mr. Starr is considered a national authority in many electrical and atomic energy fields. He was awarded the Department of Interior Distinguished Service Award and Gold Medal by Secretary F. A. Seaton, February 5, 1958, for his distinguished service to the Government in the electrical engineering and nuclear power fields. Mr. Starr served on the following AIEE Committee: Research (1941-43, 1955-57); Transmission and Distribution (1944-57); Basic Sciences (1951-57); Sections (1953-57); Safety (1954-55); Nucleonics (1955-56); Professional Conduct (1956-57).

## Nominated for Institute Treasurer

**C. H. Linder** (M '54, F '57), vice-president, engineering services, General Electric Company (GE), New York, N. Y., has been nominated for the office of treasurer of the AIEE. Mr. Linder was born in Omega, Wis., on January 18, 1903. He is an alumnus of the University of Texas, from which he helds both a bachelor's and master's degree in electrical engineering. His association with GE began in 1924 as a student engineer, from which assignment he went on to instruct in—and eventually be in charge of—GE training courses in design and application engineering. His early work in engineering centered on experimental and analytical studies in the theory of electrical machinery. He managed both engineering and manufacturing operations relating to a wide variety of GE products, ranging from heavy apparatus to consumer goods. In 1950, he became general manager of the company's activities in the large appliance field. He was elected a vice-president in 1953. As vice president, engineering, his principal concern is the effective direction of effort and use of resources in engineering throughout GE; he is also a

C. H. Linder

member of the Executive Office. An important segment of his activities centers on scientific and technological relationships both inside and outside the company. His memberships and offices in technical societies and organizations include: AIEE representative to United Engineering Trustees, Inc., and the National Engineers Committee of Engineers Joint Council; member of the American Society of Mechanical Engineers, National Society of Professional Engineers, American Association for the Advancement of Science, and permanent member of the U. S. National Committee of CIGRE. In carrying out the responsibilities of his position, he is deeply interested in total world-wide progress in science and technology and has traveled extensively in important industrial areas of Western Europe and the USSR. He has twice been the recipient of the honorary degree of doctor of engineering. Mr. Linder has been a director of the Institute since 1956. He is a member of the Finance Committee (1956-58, chairman 1957-58); Planning and Co-ordination Committee (1956-58); and Executive Committee (1957-58).

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**C. P. Knost** (M '37), district manager, Moloney Electric Company, New Orleans, La., has been elected by the AIEE Board of Directors at its meeting on February 7, 1958, as vice-president of the new South Central District (No. 13) to be established August 1, 1958, for the term of two years beginning August 1, 1958. Mr. Knost was born in Pass Christian, Miss., and attended Mississippi A&M College. He completed a two-year college engineering apprentice course at Westinghouse Electric and Manufacturing Company (now Westinghouse Electric Corporation) and then did electrical work for copper mining companies for five years. After service in the U. S. Army during World War I, Mr. Knost was with Westinghouse as an application engineer for 17 years handling all types of apparatus. Following this, he joined Moloney Electric Company and has been their district manager in New Orleans since 1936. Mr. Knost served as chairman of the AIEE New Oleans Section Membership Committee in 1942-43, during which time his committee set a record for the Section by increasing membership more than 30%. He was chairman of the New Orleans Section, 1943-44, and has been an active member of its Subsections Committee for a number of years. Mr. Knost initiated and helped to develop subsections at Baton Rouge and Shreveport, La., and Jackson, Miss., and is now assisting in the formation of a subsection at Monroe, La. Two of these subsections, Shreveport and Jackson, have now attained the status of Sections. Throughout his career, Mr. Knost has been very active with the Student Branches of Tulane and Louisiana State Universities. He has been a member of the Louisiana Engineering Society statewide vocational guidance committee for three years, and was a member of the Board of Directors of the society, 1950-51. He has also been active in civic work. He served on the AIEE Sections (1947-54).

*C. Bennette Moore*

**C. P. Knost**

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**W. K. Gengelbach** (AM '54), chief of the directorate of research and development at Holloman Air Development Center, has been appointed assistant manager of Air Force Missiles Projects at Aerophysics Development Corporation, Santa Barbara, Calif., a subsidiary of Curtiss-Wright Corporation.

**S. E. Franklin** (AM '52), senior consulting and application engineer, Westinghouse Electric Corporation, has been appointed manager of the industrial reactor development group of Control, a Division of Magnetics, Inc., Butler, Pa.

**J. S. Smith** (AM '48), director of defense engineering of the Control Instrument Company, subsidiary of Burroughs Corporation, has been elected vice-president and treasurer of All-Tronics, Inc., Westbury, N. Y. He also was elected a director of the company.

**R. J. Biba** (AM '52), engineer, Commonwealth Edison Company, Maywood, Ill., has been appointed plant engineer at Argonne National Laboratory, Lemont, Ill.

**R. E. Morris** (AM '47, M '53), manager of industrial sales for the Industries Group in Allis-Chalmers Manufacturing Company's Washington, D. C., office, has been appointed manager of the Group's St. Louis district.

**W. E. Losie** (M '46), assistant director of the engineering co-ordination and services department, The Detroit Edison Company, has been promoted to director of the department.

**R. F. Childers** (AM '51), service engineer, Hughes Aircraft, Los Angeles, Calif., has been appointed central region surface engineer for BullDog Electric Products Company, Detroit, Mich.

**R. A. Baker** (M '56), power project engineer, electric engineering department, Public Service Electric and Gas Company, Newark, N. J., has been named assistant chief engineer. **H. S. Blauvelt** (AM '48), division substation engineer, New Brunswick area, has been named division substation engineer of the Essex Division.

**E. P. Dunlaevy** (AM '41), vice-president, Phelps Dodge Copper Products Corporation, New York, N.Y., has been elected executive vice-president.

**H. H. Schenck** (AM '39, M '47), managing director of Companhia Radio Internacional do Brasil and vice-president and director of Standard Electric S.A., Rio de Janeiro subsidiaries of International Telephone & Telegraph Corp., has joined Page Communications Engineers, Inc., Washington, D.C., as director of engineering.

**D. F. Hazen** (AM '41, M '54), superintendent and district manager, The Western Union Telegraph Company, Cleveland, Ohio, has been appointed assistant vice-president with headquarters in New York, N.Y. Mr. Hazen served on the AIEE Telegraph Systems Committee (1951-57).

**Hayes Crapo** (AM '48, M '57), design engineer, The Leland Company, division of American Machine & Foundry Company, has been named chief engineer of aircraft products of Leland.

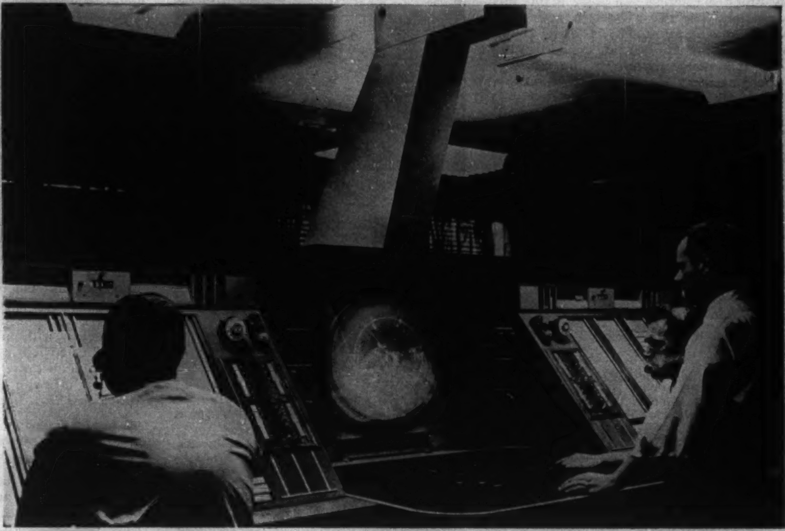
## OBITUARIES

**Lyman Coleman Reed** (AM '38), president, Lyman C. Reed, Inc., died recently. Born in Jeffersonville, Ind., in 1875, Mr. Reed was a pioneer in the electrical industry in New Orleans, La., where he started with the Edison Electric Illuminating Company (now New Orleans Public Service, Inc.) in 1892. From 1900 to 1914, he was an electrical contractor. Since 1914, he had been in the manufacturers' agency business which is still operating as Lyman C. Reed. Inc. Until his retirement in 1949, he had been active as a manufacturer and inventor. In 1932, he designed a window fan and founded Reed Unit-Fans, Inc. He obtained patents on grounding outside sheaths of insulated cables in 1900, on an electric self-regulating incubator in 1910, and on a magnetic trip panel type air circuit breaker in 1920. At his death, he was chairman of the board of Reed Unit-Fans, Inc., and president of Lyman C. Reed, Inc. He was a lifetime member of the Louisiana Engineering Society, past president of the Electrical Association of New Orleans, and past national chairman of the Propeller Fan Manufacturers' Association.

**Alfred Stamford LeVelle** (AM '43, M '54), senior engineer, Southwestern Bell Telephone Company, Dallas, Texas, died recently. Born in Havana, Cuba, in June 1901, Mr. LeVelle grew up in San Antonio, Texas. In 1923, he was employed by the Southwestern Bell Telephone Company plant department where he performed various assignments until 1941 when he joined the engineering department as a communications engineer. In 1949, Mr. LeVelle was elected chairman of the Dallas–Fort Worth Chapter of the Institute of Radio Engineers.

CORRECTION: On p. 180 of the February 1958 issue of *Electrical Engineering*, the affiliation of V. W. Lowe should read: Erskine, Heap & Co., Ltd., Manchester, England.

# OF CURRENT INTEREST



*SPANRAD (superimposed panoramic radar display) combines radar display and operations board image on same television picture tube. Overhead box contains Vidicon television pickup for obtaining image of board. Scan conversion permits daylight viewing of transformed radar information on convenventional television receiver.*

*Courtesy INTEC*

## Radar Information Is Converted to Television Signal

**SCAN CONVERSION EQUIPMENT** takes conventional radar information and converts it into a composite television signal permitting direct viewing on a conventional television receiver. The advantages of a scan converter over the conventional plan position indicator (PPI) radar display are detailed.

### Advantages

The controllable video transformation tube retains target information that allows the operator to see the past track of the aircraft and also predicts its future position (memory characteristic).

A bright display is obtained that permits viewing in full daylight (conventional radar displays normally require a darkened room for viewing).

A wide variety of relatively inexpensive studio television equipment is locally available for use with the scan conversion equipment.

It provides higher solution than the PPI (no blooming of target echoes or sweep trace).

The transformed radar picture may be easily transmitted from one control center to another by means of conventional microwave equipment or coaxial cable.

Video transformation tube *TMA-403X* provides a controllable link between the radar and television circuits. The *TMA-403X* employs two axially opposed guns in a single cathode ray tube. One gun writes radar information with its electron beam on an internal target membrane. The other gun reads television information from the target membrane. It is a semiconductor type storage tube in which the two guns are in a physical arrangement that allows instantaneous transformation of video signals from one co-ordinate system to another (polar to rectangular) through simultaneous and nonsynchronous scanning of both sides of the target membrane.

At the center of the *TMA-403X* tube is a target collector group. The group consists of a collector which is referred to as $C_1$, a correction ring which is referred to as $C_2$, and a target membrane which is similar in operation to a mosaic screen.

### Operation

The reading gun charges one surface of the target membrane to approximately the potential of collector $C_1$. A thin aluminum film on the other surface of the target membrane is attached to a metal ring at the output of the target, which is a ground potential. Because of the proximity of these members, $C_1$ is held at a safe potential to prevent breakdown of target insulation.

The correction ring is used to reduce the level of the parasitic shading signal. This signal appears in camera tubes having a secondary emission greater than 1. The voltage of $C_2$ is approximately equal to that of $C_1$. The exact value is determined experimentally for each installation.

The output signal, in the order of a millivolt for a load impedance of 2,000 ohms, provides a maximum useful current of 0.5 microampere. It is possible to read the output signal of the target group from 15 seconds to over 2 minutes before erasure of written information; this, however, is a function of the operating point of the tube. Storage is controlled by the voltage applied to the collector, the writing-beam current, and the reading-beam current. The target is erased by reversing the voltage relationship between the target membrane and the collector.

For its writing function, the scan converter requires radar trigger, synchro information from the radar antenna, and radar video information. The trigger is used internally to develop the radar sweep and range marks. The antenna synchro information is used to develop the antenna rotation and angle marks information. The radar video is presented without modification. The results of these operations are applied in standard PPI form as a charge pattern on the memory surface of the *TMA-403X* video transformation tube.

The read-out is accomplished in the following manner:

1. A master synchronizing generator, locked to the 60-cycle line frequency, develops the television timing signals for the horizontal and vertical triggers, horizontal and vertical blanking, and horizontal and vertical unblanking of the picture signal transformation tube.
2. The reading beam of the tube is deflected in television raster form by the aforementioned signals. Television video information is thereby generated at the target membrane of the visual image transformation tube. This information is collected and mixed with the necessary synchronization and unblanking information to produce a composite television signal.

In control room operation, scan conversion equipment will facilitate less fatiguing observation of displays and help to solve the increasingly complex air traffic problem.

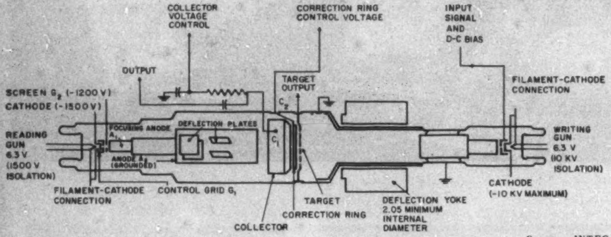
The scan converter has been used in conjunction with CPN, ASR, and FPS series of radars.

The Civil Aeronautics Administration (CAA), U. S. Department of Commerce, has ordered thirteen *TI 440* scan converter units to be installed at CAA operated air route traffic control centers and airport traffic control towers to be selected.

Initially, radar data will be run by the CAA through this equipment and then displayed on 20-inch horizontal television monitors. However, the converted radar information is readily adaptable to other types of display and may be projected onto huge screens, if desired.

*Courtesy INTEC*

**COMBINED radar, aircraft identification, and airways layout can be displayed in high-ambient light area by superimposing televised picture of controller's working table on radar screen. Procedure, called SPANRAD, was tested at CAA's Technical Development Center at Indianapolis, Ind.**


COLLECTOR VOLTAGE CONTROL
CORRECTION RING CONTROL VOLTAGE
INPUT SIGNAL AND D-C BIAS
OUTPUT
TARGET OUTPUT
FILAMENT-CATHODE CONNECTION
SCREEN $G_2$ (-1200 V)
CATHODE (-1500 V)
$C_2$
FOCUSING ANODE $A_1$
DEFLECTION PLATES
$C_1$
READING GUN 6.3 V (1500 V ISOLATION)
ANODE $A_2$ (GROUNDED)
WRITING GUN 6.3 V (10 KV ISOLATION)
CATHODE (-10 KV MAXIMUM)
FILAMENT-CATHODE CONNECTION
CONTROL GRID $G_1$
TARGET
CORRECTION RING
COLLECTOR
DEFLECTION YOKE 2.05 MINIMUM INTERNAL DIAMETER

*Courtesy INTEC*

**SEMICONDUCTOR type storage tube drawing shows how tube employs two axially opposed electron guns in a physical arrangement that allows instantaneous transformation of visual signals from one co-ordinate form to another (usually polar to rectangular) through simultaneous though nonsynchronous scanning of the two sides of a target membrane.**

# Phosphor Coated Transparent Tube Developed

ABOUT 15 YEARS AGO, electrolytes were used to deposit phosphor on the screen of a cathode-ray tube by a liquid-settling technique. Using newly developed techniques, General Electric Company (GE) scientists are now able to deposit on the face of a tube a phosphor that is approximately 1 or 2 microns thick—a transparent film.

### Differences

Such a screen has many advantages over the thicker phosphors, which are between 15 to 25 microns thick. In powder screens, light is scattered from the crystals bouncing from the interfaces. The electron beam of the cathode-ray tube and the reflected ambient light cause a general illumination of the screen on top of which the picture or pattern must be reproduced. This is a limiting factor to contrast and resolution. This new screen has almost no crystal-interface problem and, so, practically no diffusion occurs.

The resolution of the normal screen is about 200 lines per inch, whereas that of the new screen is in the neighborhood of 500 lines per inch. The accompanying illustration shows the difference.

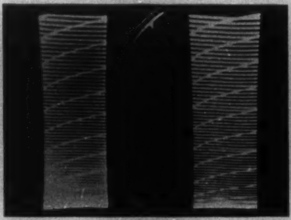
Because the new phosphor is transparent, ambient light will pass through it with a minimum of reflection and be absorbed in the tube's interior which is painted black. This means that the pattern on the screen can be viewed easily in a high ambient light.

Electron beam currents of a much higher order can be employed with the new screen without fear of burning the crystalline structure of the phosphor. This is possible because the ultrathin film is in more intimate contact with the glass which acts as a heat sink.

### Versatility

Standard phosphors of cathode-ray tubes are inclined to have noise (commonly known as "snow") and an inconstant light output. Transparent screens are practically noiseless with almost constant output. This is an important factor in radar tubes and helps to increase detection of targets.

Because of the advisability of having more than one color pattern on a radarscope screen in some instances, GE has produced the Penetron, a bicolor transparent-film screen tube. In this, one phosphor is overlaid on another, with the resulting pattern in either blue or yellow and with no interference with one another. The difference in penetrating power of the electron beam is about 4,000 volts, i.e., with 4,000 volts on the anode, the beam will actuate the top film layer and when this is increased to 8,000 volts, the beam will penetrate the top



**EVIDENCE of the high resolution possible with a thin-screen transparent phosphor tube is shown in this comparison photograph. The comparatively fuzzy test pattern, or raster (*left*), shown is achieved with a conventional phosphor 5-inch cathode ray tube. The much sharper resolution of a 5-inch transparent phosphor tube is shown at right.**

**CHECK is made of a high-resolution tube with transparent phosphor thin-screen in a pilot plant at Electronics Park, Syracuse, N. Y., by *(left to right)* Channing Dichter, Robert Dolbear, and M. B. Lees.**

layer and actuate the one next to the glass face of the screen.

A possible use for this bicolored tube is in a radar system at an airport. For instance, the system could show incoming planes' blips in blue and those of planes taking off in yellow; or the different colored blips could indicate planes flying above and below say 10,000 feet.

There is little chance that this new transparent film screen will be used for colored television picture tubes because of the deposition difficulties involved in its manufacture.

## Nuclear Power Station Is Located in Chicago Area

The picture that appears on this month's cover of the magazine shows the huge steel sphere and the building housing the turbines which have been designed for the Commonwealth Edison Company's new Dresden Nuclear Power Station as it nears completion.

This recent addition to the Illinois utility company's series of standard power stations increases their output by several thousand kw. The station is located on the Illinois waterway, some 50-miles southwest of Chicago, Ill. It is a 180,000-kw rated station that will have the largest nuclear power reactor for commercial purposes under construction in the United States. It is scheduled to be in full operation sometime in 1960.

Removal of the construction derrick which can be seen jutting out from the center of the 190-foot sphere will be the next step to be taken. This must be accomplished before either the top or the bottom of the sphere can be capped. The then airtight sphere will be given various tests in order to insure that it will be able to withstand the specified pressure of 29 pounds per square inch.

Following this extensive pressure testing, an opening will have to be cut in the side of the sphere in order to enable the entry of workmen who will make appropriate preparations in the interior for the installation of the boiling water reactor assembly.

The Dresden Nuclear Power Station of the Commonwealth Edison system is being built for the utility company by the General Electric Company under contract.

## Water-Purity Problems in Manufacturing Process Solved

The problem of purity of water used in manufacturing processes is often one of the major problems faced when plant locations are contemplated. Many methods of solution are possible, each pertinent to the locale of the manufacturing plant.

The problem of water purity, and its ultimate solution by use of a demineralizer, is presented in the following paragraphs taken from the reports of the Penfield Manufacturing Company, Meriden, Conn., installers of the demineralizing equipment.

**AN OPERATOR at the Western Electric Allentown Works changes cartridges on a T-20 unit.**

**CONTENTS of seven canisters are regenerated at one time in the SR-1 regenerator. Single operator prepares acid and caustic solutions and then sets the sequence time switch which handles separating, regenerating, reloading, rinsing, testing, semiautomatically.**

In few manufacturing operations is quality control as critical as in the production of semiconductors and electron tubes. At Western Electric Co. (WE), for example, undesirable chemical residues in excess of one part in 10 million are intolerable in many operations.

But, it is one thing to set up such rigid specifications and another to achieve them. For instance, in the manufacture of transistors, a very serious problem is the production and circulation of water pure

### Future Meetings of Other Societies

**The American Society of Mechanical Engineers,** *Instruments & Regulators,* Conference, joint IRE–ISA–AIChE, Apr 2-4, U of Delaware, Newark, Del. W. E. Vannah, Control Engineering, 330 W 42nd St, New York 36, N. Y.

*Maintenance & Plant Engineering,* Conference, Apr 14-15, Penn-Sheraton Hotel, Pittsburgh, Pa. L. S. Dennegar, ASME, 29 W 39th St, New York, N. Y.

**The Institute of Radio Engineers**

*Electronic Wave Guides Symposium,* joint Polytechnic Institute of Brooklyn, Apr 8-10, 33 W 39th St, New York, N. Y. Jerome Fox, Microwave Research Institute, 55 Johnson St, Brooklyn 1, N. Y.

*Southwestern Conference & Electronic Show,* Apr 10-12, Municipal Auditorium, San Antonio, Texas. J. B. Rives, Ground Communications Division, San Antonio Air Materiel Base, San Antonio, Texas.

*Spring Meeting,* joint U. S. National Committee of URSI, Apr 24-26, Willard Hotel, Washington, D. C. J. P. Hagen, Naval Research Laboratory, Washington, D. C.

**11th Annual Conference for Protective Relay Engineers,** Apr 14-16, Dept of Electrical Engineering, A & M College of Texas, College Station, Tex. L. M. Haupt, Texas A & M, same.

**Instruments, Electronics & Automation Exhibition,** Apr 16-25, Olympia Hall, London, England. Industrial Exhibitions Ltd, 9 Argyll St, London, W1, England, or any U.S. British Consulate.

**Institute of Environmental Engineers,** 2nd Annual Meeting and Equipment Conference, Apr 17-18, Hotel New Yorker, New York, N. Y. R. J. Amorosi, Parameters, Inc., 195 Herricks Rd, Garden City Park, L. I., N. Y.

**AIChE,** meeting, Apr 20-23, Sheraton-Mt. Royal Hotel, Montreal, Que., Canada. F. J. Van Antwerpen, AIChE, 25 W 45th St, New York 36, N. Y.

**SMPTE,** 83rd Convention, Apr 21-25, Ambassador Hotel, Los Angeles, Calif. H. E. Farmer, Cinema Dept, U of Southern Calif, Los Angeles, Calif.

**1958 Electronic Components Conference,** Apr 22-24, Ambassador Hotel, Los Angeles, Calif. D. M. Knox, Packard-Bell Electronics Corp, 12333 W Olympic Blvd, Los Angeles 64, Calif.

**The Electrochemical Society, Inc,** meeting, Apr 27–May 2, Hotel Statler, New York, N. Y. J. L. Everhart, Reinhold Publishing Corp, 430 Park Ave, New York 22, N. Y.

**Petroleum Industry Electrical Association,** convention, joint PESA, Apr 29–May 1, Adolphus Hotel, Dallas, Tex. T. B. Kelley, PIEA, P.O. Box 1612, Shreveport, La.

**1958 British Electrical Conference,** May 16-17, Palace Hotel, Brussels, Belgium. Sam Black, FIPR, 1958 British Electrical Conference, 36 Kingsway, London, WC2, England.

**The Institution of Electrical Engineers,** International Convention on Microwave Valves, May 19-23, Institution Building, Savoy Place, London, WC2, England. W. K. Brasher, IEE, same.

**World Assembly of Association of Engineers & Architects in Israel,** joint Technion, May 29–June 8. Sol Pincus, c/o American Society for Israel Institute of Technology, Inc, 1000 5th Ave, New York, N. Y.

**CIGRE,** 17th Biennial Session, June 4-14, Paris, France. CIGRE, U.S. National Committee, 50 Church St, Rm 1777, New York 7, N.Y.

**7th International Inventors Exhibition,** June 6-29, Institut des Arts et Metiers, Brussels, Belgium. O. A. Witt, P.O. Box 1481, Milwaukee 1, Wis.

**International Organization for Standardization,** Triennial Meeting, June 9-21, Harrogate, Yorkshire, England. U. S. member: American Standards Assoc, 70 E 45 St, New York 17, N. Y.

enough to rinse the germanium and silicon crystals before assembly. Virtually any metallic or other ions present in the rinse water will leave chemical residues which will interfere with yields, reproducible electrical characteristics, or life of the product.

A number of solutions were considered at the WE Allentown (Pa.) Works. First, piping high quality demineralized water through existing stainless steel lines from a central source, a distance exceeding 300 feet, was considered. However, it was found that the purified water tended to leach out metallic ions from the pipe and it was known that corrosion and organic matter form at the fittings, so that when it reached the point of use, a minimum resistance of 5 million ohms could not be guaranteed.

Other means of distributing high quality water were tried, too, such as the use of bottled deionized water. However, problems concerned with glass dissolution during storage of high quality water and increasing demands of production ruled it out because of the cost of bottling the water at a centralized location and transporting it to the separate points of use.

After further thought and consultation, WE's chemical engineers decided that the best approach was to produce water of the specified purity right at the various points of use. It was decided that this could best be accomplished by "scavenging" already demineralized water received from the central source.

To implement this idea, WE contacted a water demineralizer producer, Penfield Co., and together they worked out a water-treating system based on secondary point-of-use purification of influent with a resistance of 100,000 ohms or better received from the distribution system. Key to the system is a Penfield monocolumn unit containing intimately mixed anion and cation resins. Designated model *T-20*, this unit has a capacity of 40 gph, is portable, easy to use, and features plastic construction of all wetted parts. Continual monitoring of water quality by the operator is permitted through the use of electronic conductivity bridges installed right in the line. This permits an accurate measurement of water uncontaminated by air or an open container.

In actual use, the *T-20* units will remove any ions remaining in the entering water to bring the resistance up as high as 18 million ohms. Upon continuing use, this resistance will drop until a minimum of 5 million ohms is reached after a time, dependent on the extent of use.

At this point, the resin cartridge is removed and replaced with a fresh cartridge. The spent cartridge is taken to a special Penfield regenerator, where, at the operator's convenience, seven such cartridges can be regenerated at one time.

The obvious advantage of the demineralizers is that they meet all purity specifications and permit simple, trouble-free operation. Moreover, the cost of producing this highly purified water after equipment amortization is very low.

WE started using the model *T-20* units in 1954, adding more as production increased until now the company has some 30 units in use in their production department.

**CASCADE WASHER is used to rinse electron tube parts. Ultimate water purity is achieved by continuous recirculation.**

## Ultraprecise Compass for DC-8 Ocean and Polar Flights

Transoceanic and over-the-pole flights of 570-mph Douglas *DC-8* jet airliners—soon to cut flying time in half between points on opposite sides of the globe—will be navigated with unprecedented accuracy.

A specially developed compass system that affords precision never previously achieved in commercial aviation has been specified by 14 domestic and foreign flag carriers which have ordered the jetliners for ocean-spanning routes, it was announced recently by Douglas Aircraft Company and Sperry Gyroscope Company.

The Sperry *G-11* compass system affords gyro random drift rates as low as one-half degree per hour, while gyro systems in general use today drift from three to eight degrees hourly.

The extremely accurate compass systems will enable air crews to navigate precisely over areas where ground radio facilities are not available and at high latitudes where magnetic compasses are unreliable, it was stated by Sperry's Aeronautical Equipment Division.

A counterpart of the *C-11*, the *C-10* system which provides the accuracy required for the most difficult continental flights, has been adopted as standard for the *DC-8*. Both systems can be coupled with the Sperry *SP-30* flight control system, also standard on the *DC-8*, to provide precision control of the luxury jetliners from a relatively slow 100-mph to sonic speeds.

The earth, in effect stands still at this point deep within guarded areas of a Sperry Gyroscope Plant. Rugged, but superaccurate gyros for various inertial systems are oriented on a true line to Polaris (North–South) within plus or minus 2 seconds of arc, for an 8-hour checkout of varying high altitudes. Then the machine, specially designed by Sperry, flops to East–West (true) for another 8-hour "test flight" at the equator.

*Clevite Corporation Brush Instruments Div. Photo*

**CHART RECORD of arc variations and other phenomena are immediately available from direct writing oscillograph seen in foreground.**

The direct writing oscillograph, manufactured by the Brush Instruments Division of Clevite Corporation, creates an immediately available, permanent chart record of arc variations and other phenomena. A chart record is sent with the gyroscope to Sperry customers as a measurement of performance.

To remove the earth's motion during the 16-hour test, and to hold the gyro's true "fix" on outer space, a rotating base automatically compensates for exact earth-surface movement at the plant's precise latitude through gears held within 2-second precision limits.

## Engineering Title Standards Proposed by NSPE

At a recent meeting of the National Society of Professional Engineers (NSPE), it was resolved that engineering titles should be used in position description only when the individual meets a minimum standard of qualification. According to a policy statement adopted last month by the NSPE Board of Directors, to qualify for an engineering title the person should be either registered under a state engineering registration law, a graduate of an accredited engineering curriculum, or be covered by an official ruling under the Taft-Hartley or Fair Labor Standards Act relative to an engineering position and "professional" status under one of the two laws.

In presenting the policy statement, the full text of which is quoted in the following paragraphs, it was stated that, ideally, individual qualification for an engineering designation should be controlled by registration as a professional engineer, or certification as an engineer-in-training under the state laws. However, as a practical first step to eliminate the more serious abuses, the policy accepts other minimum standards which can be tested on a factual basis. The policy excludes application to subprofessional positions, such as "engineering assistant," or "engineering aide."

"POLICY STATEMENT—*Engineering Titles:* The progress of recent years in professional attitudes and practices on the part of employers and professional engineers can be substantially speeded and improved by recognizing and treating the problem of engineering titles.

"Experience in such matters as labor cases, administrative rulings, classification systems and others has shown repeated examples of the conferring of engineering titles upon individuals or groups who are not qualified professionally by any acceptable standards of law or engineering practice. Both employers and employees have been parties to the indiscriminate use of engineering titles. Engineering titles or designations have been accorded employees who may be associated with an engineering department or activity, but who are clearly not engineers in a professional sense. These have been accorded through position classification systems, organizational charts, advertisements, promotional literature, articles, speeches, company bulletins, payroll records, etc.

"It is believed that new and further definitions are not necessary. Adequate standards now exist through accepted definitions of laws, as well as accredited collegiate curricula. To make substantial progress in this area it is suggested that employers and the profession should now move toward the acceptance of guidelines by which the term, "engineer," will be recognized in a proper manner.

"For the reasons stated, and recognizing that mutual employer–employee professional relations will be furthered thereby, the following standards are suggested as the only basis on which any title or designation should include an engineering reference:

"1. Registration as a professional engineer-in-training under a state engineering registration law.

"2. Graduation from an accredited engineering curriculum leading to a bachelor's degree.

"3. An official ruling designating an individual or a group in an engineering capacity as meeting the definition of "professional employee" under the Taft-Hartley Act, or the Fair Labor Standards Act.

"All persons not coming within one of these categories should be designated by an appropriate title without reference to "engineer" or "professional engineer."

"This policy shall not be construed to prohibit titles such as "engineering assistant" or "engineering aide" where the title clearly implies that the position is of a subprofessional nature.

"Adopted by NSPE Board of Directors, October, 1957."

## Electron Tube Works after Explosion

Ability of precision electronic components to work perfectly after shattering explosion and impact in test flights of long-range missiles was confirmed recently by scientists.

In one recent instance, after midair explosion and 1½ mile free-fall impact against the sea, a super-rugged electronic oscillator proved to be precise within 0.01% of its "ideal" operating frequency. The component, later dredged from the ocean floor and returned to the laboratory, had been a key part of a long-range missile that deliberately was blown to bits during final phase of its supersonic test flight from Cape Canaveral, Fla.

**KLYSTRON OSCILLATOR, retrieved after midair explosion in long-range missile and 1.5-mile free fall sea impact, is examined in electronics laboratory by Dr. V. E. Learned (*left*), director of klystron research, and Dr. J. T. Muller (*right*), shock and vibration analyst.**

The device is a precision klystron oscillator developed by engineers at the Sperry Gyroscope Company for a critical guidance and data system produced for several missiles. It was returned to the electronic laboratories for study by shock and vibration experts.

Scientists calculated (from the slight deformation of its heavy cooling fins) that the recovered klystron unit had: (1) withstood shocks greater than 100 g when explosion of the missile blasted the unit from its mounting and scattered missile parts over miles of ocean and (2) smashed against the surface of the ocean at a speed of several hundred miles per hour after its free fall through the atmosphere.

"At that speed water acts like a solid wall of concrete," commented Dr. V. E. Learned, Sperry director of klystron research and development. adding that destructive tests are necessary to reveal weaknesses because missiles cannot be developed without them.

"Like the detective reading clues, we measure scratches and dents of severely tested components to find out how much punishment each can stand before failing," he said. "This indicates how well a component can be relied upon at the critical moment of its mission."

Valuable technical data yielded by a single long-range missile test flight would, if published in tabular form, fill a book at least one foot thick, scientists point out.

## Advance in Memory Devices

A magnetic memory concept, named the "Twistor," is expected to make possible memory systems which are simpler to fabricate and more economical to manufacture than existing systems. The result of experimentation by A. H. Bobeck at Bell Telephone Laboratories, the "Twistor" may have extensive applications in computers and electronic switching systems where rapid-access high-capacity memories are necessary. It opens the way for the construction of magnetic memory arrays merely by interweaving horizontal copper wires and vertical magnetic wires.

This device gets its name from a characteristic of wire made of magnetic material. Torsion applied to such a wire shifts the preferred direction of magnetization from a longitudinal to a helical path. The coincidence of a circular and a longitudinal magnetic field can then be used to insert information into this wire in the form of a polarized helical magnetization, and the magnetic wire itself can be used as a sensing means.

In practice, a circular magnetic field is provided by a current pulse through the magnetic wire, and a longitudinal field by a current pulse through the copper wire which is perpendicular to the magnetic wire. Thus, storing a bit requires two coincident current pulses. Readout is accomplished by overdriving the longitudinal field in the reverse direction. The readout signal is sensed across the magnetic wire. Because the lines of magnetic flux along the helical path wrap the magnetic conductor many times, a favorable increase in the output signal is obtained.

**MAGNETIC memory array in experimental set up at Bell Telephone Laboratories to evaluate the "Twistor" concept. The longitudinal magnetic field for the magnetic wires is provided by small solenoids wound around glass tubes.**

In conventional magnetic core memory devices, conductors must be threaded through the cores to make up a suitable matrix. When a ferrite sheet is employed, either a threading or a plating operation is necessary to locate the conductors properly. However, with the "Twistor," the ferrite material is eliminated completely and no threading or plating is necessary. Speed of operation and output of the "Twistor" are comparable to ferrite memory systems.

## Machine "Reads" Handwritten Numerals

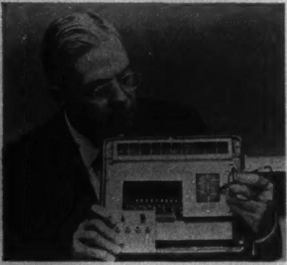
An experimental device that can "read" handwritten numerals or identify numerals as they are being written has been announced by Bell Telephone Laboratories' system engineering department. The machine, demonstrated recently at the Eastern Joint Computer Conference, could prove valuable in telephone offices or in any situation where it is necessary to write and identify large quantities of numerals.

The machine recognizes numbers as they are being written and indicates the numeral by lighting up the correct digit on a numbered panel. The writing is done with a metal stylus on a specially prepared writing surface. Two dots, one above the other, are used as reference points around which the numerals must be formed. Seven sensitized lines, or radius vectors, extend from these two dots. Numerals are sensed by the machine, depending on which lines are crossed.

The writer clears the device for the next number by touching the stylus to a special plate which causes the previous number to be "erased."

A pencil containing a conductive lead must be used in order to recognize previously written numerals. The ticket is then inserted in the machine into a special slot under a plate that has seven sensitized lines, using the same principle for recognizing numbers already written as it does for the ones written on the machine with the stylus. The machine-gathered information can be transferred to an accounting machine, computer, or other data-processing device.

Several experimental models have been built at Bell Laboratories. Each is completely self-contained.



*Bell Telephone Laboratories Photo*

**WRITING AREA on experimental machine is pointed out by the inventor, T. L. Dimond, of unit that "reads" handwritten numerals.**

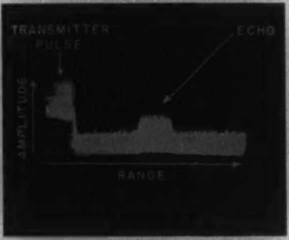
The device is operated from flashlight batteries and requires no outside power source. Its small size is made possible by the use of transistors.

## Research Tool for Ballistic Missiles Problems

A very large and high-powered long-range radar has been detecting the Soviet satellites, Sputnik I and II, at remote distances. These detections have been assisted by, and have confirmed the accuracy of, predicted positions calculated from radio observations by Lincoln Laboratory scientists and engineers of the Massachusetts Institute of Technology.

Since October 5, the day following the launching of Sputnik I, Lincoln scientists have observed by radio the passings of the satellites over the northeastern United States. Starting on the first night with a single radio receiving equipment at the Lexington, Mass., site, the Lincoln effort was expanded rapidly to include observations from four separate locations. Tape recordings of Sputnik signals have been made on both the 20- and 40-mc frequencies.

Correlation of data from these multiple sightings has made it possible to pinpoint positions of the satellites with considerable accuracy, as well as to determine current and short-term future characteristics of the orbits.



**RADAR ECHO photograph from third stage rocket of Sputnik I, 595 miles from Millstone Hill, MIT Lincoln Laboratory site.**

The Millstone radar first observed Sputnik II on November 7 at 12:05 a.m. From these observations, measurements of range, elevation, bearing, and Doppler frequency were made. At this time, the height of the satellite was 152 miles.

The Millstone radar was designed for use as a research tool, primarily for the study of problems in ballistic missile defense. It will provide valuable information on the operation and applications of high-power, long-range radar and will be of assistance in securing a better understanding of the radio effects of meteors and the aurora.

Specially designed high-power klystron tubes, 11 feet in height, provide the transmitting power.

The antenna system consists of a parabolic reflector, 84 feet in diameter, mounted on a concrete and steel tower 90 feet high. The rotating portion of the antenna structure weighs 90 tons. With a horizontal rotating capability of 360 degrees and a vertical elevating capability of 90 degrees, the antenna can sweep the sky.

The high degree of precision required by the Millstone radar made it necessary to position the antenna with such accuracy that the minute bending of the antenna tower caused by uneven heating by the sun could not be tolerated. This bending was minimized by painting the surface of the tower white to secure maximum reflectivity of the sun's rays.

*Guenther Law Photo*

**ANTENNAS at Cape Canaveral and other locations will resemble this unit already in place at a defense location. Shack contains recording and operating equipment.**

The Millstone Hill facility will support co-operation between the U. S. Air Force and the Defence Research Board of Canada in research concerning the ballistic missile defense of North America. As a part of this co-operation, a joint United States–Canadian announcement was made recently of a large radar installation proposed for the Prince Albert area of Saskatchewan. In the development of this project scientists from the Defence Research Board's Telecommunications Establishment are working closely with the Lincoln Laboratory staff, representing the interests of the U. S. Air Force.

The high-powered, long-range radar antenna installation designers and builders said that the installation is only one link in a chain of advance-design antennas which were already in operation in October when the Soviet satellite began its globe-girdling flight.

These huge parabolic radio telemetry antennas, weighing 35 tons each and featuring an aluminum reflector measuring 60-feet in diameter, will be used to track the test model of the three-stage rocket scheduled to be fired by the U.S. Navy at Cape Canaveral.

Correlation of data from these D. S. Kennedy & Co. antennas, will make it possible for United States scientists to pinpoint the flight of the rockets and satellite at all times, recording each specific altitude and stage of flight. The radio telemetry antennas will be augmented in tracking operations by the MINITRACK complex of antennas, consisting of flat reflectors mounted parallel to the ground.

The largest radio telescope in the nation, which was recently completed by Kennedy at Riverside, Md., for the Radio Astronomy branch of the Naval Research Laboratory, stands almost 100 feet high and weighs 90 tons. With it, U.S. Navy scientists will be able to detect objects in space at even greater ranges than the giant radar trackers. The Riverside installation is powerful enough to detect a 1-watt signal at 5 million miles.

These antennas in the United States, Canada, and West Europe feed vital information to defense centers throughout the free world.

## Transparent Magnetic Oxides

A class of magnetic oxides, structurally distinct from ferrites, has recently been discovered. These materials, known as rare-earth-iron garnets, are transparent, permitting the internal magnetic domain structure to be seen with a polarizing microscope.

The discovery of ferrimagnetism in these garnets was made first at the Laboratoire Electrastatique et de Physique du Metal of the Institute Fourier in Grenoble, France, and independently by S. Geller and M. A. Gilleo of Bell Telephone Laboratories, where the optical and magnetic resonance behavior of the garnets is being studied by J. F. Dillon, Jr., employing single crystals grown by J. W. Nielsen.

Most magnetic materials, metals, and ferrites alike, are opaque to visible light. Thus, their internal magnetic structure is not visible, and the way magnetic domains are oriented within them has been inferred from reflection of polarized light by their surfaces or by delineating domain boundaries at these surfaces with colloidal magnetic oxides.

Yttrium iron garnet, $Y_3Fe_2(FeO_4)_3$, is the most completely studied member of this new garnet family. It has a Curie temperature of 545 degrees Kelvin and a spontaneous magnetization at zero temperature and infinite field of 4.96 Bohr magnetons per molecule, close to the theoretical value of 5.0. This magnetization results from superexchange interactions through the $O^{2-}$ ions between $Fe^{3+}$ ions in crystallographically different positions in the cubic lattice. The number of these interactions per $Fe^{3+}$ ion in yttrium-iron garnet is ⅗ that in a ferrite and, correspondingly, the observed Curie temperature of 545 degrees Kelvin is 0.64 of that for magnetite (848 degrees Kelvin).

Of great interest is the fact that yttrium-iron garnet contains magnetic ions with but a single valance. Both X-ray and neutron diffraction studies have shown clearly that, unlike the ferrites, the interactions between identical magnetic ions wholly occupying two different crystallographic sites are responsible for ferrimagnetism in the garnet structure.

In yttrium-iron garnet the width of the ferrimagnetic resonance absorption line at 9,300 and 24,000 mc per second depends on crystallographic direction. Line widths of only 0.8 oersted were observed along the [100] direction in thin disks at 10,000 mc per second, when the temperature was held at 540 degrees Kelvin. These line widths increased with decreasing temperature and passed through peak values of several hundred oersteds between 65 degrees Kelvin and 4.2 degrees Kelvin.

A polarized light beam passing through the transparent magnetic domains in rare-earth-iron garnets has its plane of polarization rotated in one direction in one domain but in the opposite direction in an adjacent and oppositely magnetized domain. The Faraday rotation is wavelength-dependent and amounts to several degrees per mil of thickness; it makes the domains within the crystals clearly visible. The internal domain structure can, therefore, be studied over a wide range of temperatures and magnetic field conditions. Thus, for the first time, it is now possible to correlate Faraday rotation in a magnetic material with spectroscopic data over a broad temperature range.

## X-ray Viewer Demonstrated at AMA Meeting

A unique electronic instrument that increases readability of X-ray negatives through contrast enhancement was demonstrated during the 11th Annual Clinical meeting of the American Medical Association recently held in Philadelphia, Pa.

It marked the first utilization of the Philco EXICON (expanded image contrast) X-ray viewer before any group of the AMA.

EXICON inhanced X-ray negatives were televised from Lankenau Hospital to the AMA scientific sessions during programs presented by the Medical Color Television Unit of the Smith, Kline and French Laboratories.

EXICON quickly and accurately extracts a maximum amount of information from an X-ray negative, according to Dr. J. Gershon-Cohen, director, radiology department, Einstein Medical Center, Philadelphia.

He pointed out that this new electronic system enhances X-ray contrast in "gray scale" variations and magnifies the area being viewed. Through the application of advanced electronics and principles used in standard television techniques, EXICON significantly enhances fractional percentages of "gray scale" contrast to assist in positive X-ray diagnosis.

With this new medical electronic device a small area of any X-ray negative can be enlarged to a greatly expanded black-to-white contrast range. This sharp precise contrast enhancement enables more positive reading of important details in an X-ray negative.

The "EXICON" system consists of a monochrome television monitor, operators' console, and a flying spot scanner. An X-ray negative placed before the flying spot scanner is magnified and reproduced in enhanced monochrome. Negatives may be quickly shifted about to obtain magnified images of any portion.

The flying spot scanner converts the information on the X-ray negatives into an electrical signal in order to process the information through the contrast enhancing device in EXICON. This internally generated electron beam produced on the scanner tube's screen is focused by a system of lenses upon the X-ray negative under examination.

As this bright spot of light passes through the negative, it is picked up by a photoelectric tube. Then the light is converted into a video signal, processed by special electronic circuitry and fed to a television-type monitor where the X-ray picture is reproduced for viewing.

## Demands on Teachers in a Technological Society

This is an edited version of a speech delivered on October 24, 1957, at East High School, Denver, Colo., by Dr. F. W. Brown, director of the Boulder Laboratories, National Bureau of Standards (NBS) before the Colorado Teachers Association, Science Section.

ADVANCE IN SCIENCE and technology, as well as in any other field of human endeavor, depends primarily on the trained brainpower and skills of individual men and women. Teachers are the most important single element in society in training the brainpower and skills of these individuals during the most important period for basic training—childhood.

In the present technological age, pure science seems to control indirectly virtually all material human progress and has considerable influence in progress in what we call the humanities. With a delay of only a few years—a continually decreasing interval—science becomes technology. Technology, in turn, markedly influences our way of life and ultimately affects our political behavior and international relationships.

The development of technology today is most intense in the two predominant powers in the world today—the United States of America and the USSR. The demands on scientific resources in these two countries are further amplified by the international tension existing which has led to intense technologic competition, particularly in those fields associated with weaponry. However, at this point, that progress in weaponry is intimately dependent on scientific and technologic progress in general. As a matter of fact, the most significant technologic advance in modern times—utilization of atomic energy—was a direct result of weapons development, and both were a direct result of some 40 years' background of basic scientific research results.

Technology requires for its existence an adequate supply of competent and well-trained scientists and engineers. Much has been written the past few years about the shortage of scientists and engineers, and this is definitely a world-wide problem. Within recent months, it has been gratifying to see that there has been a greater awareness of this problem by a much wider segment of our population and, what is more important, by the educators themselves who are going to have to train the needed supply of scientists and engineers. The President himself has been behind repeated requests that industry and Government agencies aid in meeting the educational crisis in science.

As the support of science moves more and more to Government sources, it is becoming increasingly obvious that the public is essential to science and that a mutual lack of understanding will be dangerous to both. Physical science is a typical human and social enterprise, and the understanding of the physical universe and the application of this understanding to attain control of and exploit our power over physical nature is just as basic a part of human endeavor as learning how to live together in society, learning to enrich our lives with the arts, or learning to understand the functioning of the bodies and minds of man himself.

The recent launching of the Soviet earth satellite forcibly called the attention of everyone to what the scientists have always known, that we have no monopoly on advanced scientific know-how," and that we must continually strive to improve our base of scientific and technical knowledge. How well we do this depends to a great extent on teachers.

There is no doubt that the Soviets have been emphasizing science and technology and have geared their educational system to a technological society. We could not rationally adopt their approach inasmuch as we live in a democratic society. But, we must admit that they have been dramatically successful in their rapid scientific advances and, undoubtedly, we can learn something from comparing their training of scientists and engineers with our own.

Prior to 1931, Soviet education went through a period of experimentation with the ideas of "liberal" Western educators with certain Soviet Union ideological innovations—involving a "permissive" system of education. They had decided that this had led to "a senseless and deplorable state of affairs" and made a drastic change after 1931. At that time, Soviet education readopted the traditional methods of instruction with emphasis upon discipline and obedience, individual learning and grading, and mastery of certain skills and knowledge. It appears that the important motivation behind this reform was the practical consideration of a pressing need for young people to know the fundamental principles of science—in physics, mathematics, chemistry, etc.

The emphasis on science and mathematics in the elementary and high schools is much greater in Soviet than in United States schools. While the percentage of engineers and scientists among United States college graduates has decreased in recent years, the reverse has been true to a marked degree in the Soviet Union. American colleges in 1955 were graduating 59,000 scientists and engineers while USSR institutions were graduating 126,000.

Although many reasons are advanced for decreased interest in scientific and engineering training in the United States (such as, unsatisfactory salaries), there seems to be general agreement that a more important and, in fact, major factor is the lack of both quality and quantity of the teaching of science and mathematics in our schools. Many organizations are working on this problem, including the National Science Teachers Association.

At the Boulder Laboratories of the NBS, attempts are being made to foster an increased interest in science and technology among our schools by sponsoring a Science Fair for the junior high and high schools of the area, and by making NBS facilities available for such a Fair again.

As further example of what is being done, mention should be made of the National Science Foundation (NSF) which, often in co-operation with industry, is sponsoring year-long institutes in various universities for high school teachers, where the emphasis is on science and mathematics rather than pedagogy. The NSF, the National Institutes of Health, and the Atomic Energy Commission have been granting increasing numbers of fellowships in the sciences. Many industries and Government agencies allow their employes to take advanced training while being paid full or partial salary.

The most hopeful signs of all are that the scientists and engineers themselves, in increasing numbers, are beginning to take a much greater interest in the education system at the elementary and high school levels, and the teachers themselves are calling on scientists for assistance in meeting the problem of the training of scientists.

## Heart Sound Pickup Detects Inaudible Murmur

A heart sound pickup that detects chest wall movements as small as one-half billionth of an inch is "hearing" murmurs inaudible to conventional recording instruments.

Known as a capacitance heart sound pickup, the device converts an automotive engine pressure measuring technique into a supersensitive research "tool" for studies of faint heart murmurs that may reveal presence of defects of the heart's valves at an earlier stage than was possible before.

It was developed co-operatively by Dale Groom, M. D., assistant professor of medicine at the Medical College of South Carolina, and Y. T. Sihvonen of General Motors Research Staff's physics and instrumentation department, GM Technical Center.

Now being applied in heart research carried on in a soundproof room at the Medical College Hospital, Charleston, S. C., the instrument differs from microphone type pickups commonly used in phonocardiography (the recording of heart sounds) which depend on acoustical transmission of sound through an enclosed column or pathway of air.

The capacitance device, contained in a small bell-shaped housing similar to the "bell" of a physician's stethoscope, transduces or converts chest wall vibrations directly into electrical signals.

These faint signals are amplified and reproduced with a clear trace on an oscilloscope where they can be photographed or they can be recorded on tape. Thus, the pickup "hears" and detects the heart's high frequency sounds of extremely low intensity.

Sensitivity of the new instrument is such that, when used in a special soundproof room to exclude extraneous noise, many "normal" murmurs and sounds arising from the flow of blood through the heart and large blood vessels are heard. These are not audible on ordinary stethoscopic examination.

Also, fetal heart sounds—produced by a baby before birth—can be picked up and recorded from the mother's abdomen at an earlier stage of development than has been possible before.

A unique application of this type of pickup is that of recording sounds directly from the heart itself while exposed during surgery. Dr. Groom and Mr. Sihvonen reported in the October issue of *American Heart Journal* that sounds could be picked up without actually touching the exposed heart and these sounds bore "a striking resemblance to those ordinarily recorded from the outer chest wall."

## Camera Detects Intense Radiation

Location of radioactive contamination in areas too "hot" for effective use of detection instruments has been made possible by a pinhole camera fashioned from lead and uranium at the Knolls Atomic Power Laboratory (KAPL) operated by the General Electric (GE) Company for the Atomic Energy Commission (AEC).

The lead camera can detect small sources of radioactivity which cannot be pinpointed sufficiently by detection instruments, and can be used to make conventional photographs of contaminated objects which would fog film in an ordinary camera. Pointed toward the general area of contamination, the camera can record high-level radioactivity sources on film in minutes rather than the days required by conventional detection instruments.

John Payne, designer of the camera and supervisor of equipment development, explained that basically the camera is of the simple pinhole variety. However, it carries two types of film, one making conventional light negatives and the other, an X-ray film, recording atomic radiation. After development, the X-ray film can be superimposed on the conventional film to pinpoint the location of dangerous radiation sources. Usually about 12 minutes is needed to expose the conventional film and at least an hour for the X-ray film.

The camera, approximately the size of an old-fashioned box camera, weighs 29 pounds. The lens barrel is made of uranium, which is denser than lead, limiting the entrance of atomic rays to the aluminum lens inside the barrel. A pinhole in the aluminum lens admits light rays.

## Israel Engineers Plan World Assembly

The Association of Engineers and Architects in Israel, in conjunction with the Technion, will hold a World Assembly, May 29-June 8, coinciding with Israel's 10th Anniversary celebration. It will feature lectures; tours of industrial, housing, and development works throughout the country; and visits to points of outstanding interest, such as the Weizmann Institute of Science. Program and travel details are available from Sol Pincus, c/o

American Society for Israel Institute of Technology, Inc., 1000 Fifth Avenue, New York, N. Y.

## Portable Completely Automatic Film Developer

For years, scientists and engineers have had to rely on commercial processing laboratories for the development of 16-mm and 35-mm motion picture recording films. Delays of hours, days, and even weeks occurred between the time of exposure and the return of the processed film from the laboratory. In many cases, this delay either made the films obsolete or showed an error in the original set-up which required complete reshooting.

Requirements for high-speed movies, oscilloscope records, gun camera and missile films, and many other types of photographic instrumentation are such that the film must be viewed as soon as possible after the recorded event has taken place. Otherwise their evaluation may be useless and cause untold expense and frustration.

Need for an interim processor which could be used at the shooting location and which would not require skilled photographic personnel prompted Fairchild Camera and Instrument Corporation to conduct the necessary research and development required to produce such a unit. Thus was born the "Mini-Rapid 16," a complete automatic, self-threading, tabletop processor capable of turning out 100-foot rolls of 16-mm film, processed and dried in less than 20 minutes.

Independent of all utilities, except for ordinary 110 volt a-c, the new Fairchild processor can be used in odd corners of the laboratory, deserts, and other such locations where even water is scarce.

The ability of the Mini-Rapid 16 to develop an ordinary black and white film ready for projection on a screen is expected to be of greatest value in engineering photographic work.

First of a family of film and paper processing equipment to be developed as shelf items, this unit is the result of years of research and development in the design of miniaturized and portable airborne processors for the U. S. Air Force, Army Signal Engineering Laboratories, and U. S. Navy.

Major elements in the tiny processor, about the size of a standard file drawer, are: easily interchangeable film transport plastic inserts containing high-speed developer, rapid fixer, hypo eliminating agent, and static rinse with resultant film of commercial quality. In addition to this, more permanent quality is easily obtained by running the film through a second time with the tanks filled only with water. A wide-range capacity in film length and longevity of chemical solutions are two more features of the unit. Film lengths as short as one foot or as long as 400 feet may be processed without the necessity of changing or replenishing the chemical solutions.

Construction is of welded stainless steel with an aluminum rear housing affording lightness, rigidity, and economy. All chemical tanks, which hold 18 ounces of liquid each, are easily removable for rinse cleaning and renewing of solutions. All compartments are accessible for clearing and wiping by hand and the unit is ordinarily placed on a table top for operation, no fasteners are required.

Rubber rollers on the plastic insert assembly serve a triple function—drive rollers for film transport, as a means of agitation, and squeegeeing the exhausted solution back into the solution container.

The film is guided in its path by grooves in the sides of the plastic inserts, automatically transported to the next rubber roller and on through each insert, and dried by impingement of heated air on the emulsion side of the film while the base side is held against a driven fabric belt.

Take-up, the second manual operation is accomplished by attaching the leading edge of the processed film to a standard daylight loading spool and dropping the spool into the take-up compartment where it rides on an overdriven rubber covered film spool.

It is possible to adjust the rate of processing for over- and underexposed film and/or temperature variations.

**MOTION ANALYSIS CAMERA records shock, shear, and tear characteristics of new titanium alloy. Allowing 15 minutes for set-up time, (*right, top to bottom*), research engineer will be able to view pictures taken by high-speed Fairchild camera. This is the first automatic self-feeding portable rapid film processing device able to develop dry-to-dry 16-mm film at rates of up to 10 feet per minute. Operator feeds only first 2 inches of film into slot in compartment, examines for proper development, and makes adjustments as needed. Entire 100-foot roll, finished and wound on spool at rate of 6 feet per minute, is ready for screen projection and viewed by analysis engineers.**

**Start**

**3 minutes**

**5 minutes**

**20 minutes**

**23 minutes**

## Battelle Institute Names New President

The appointment of Dr. B. D. Thomas, scientist and research administrator, as president of Battelle Memorial Institute was announced recently by the Institute's Board of Trustees. Dr. Thomas has been a member of Battelle's staff since 1934, becoming Assistant Director in 1942, Vice President in 1955, and Director in 1956. He headed Battelle's first Division of Chemical Research in 1939, and was a key figure in the establishment of the Institute's research laboratories in Frankfurt, West Germany, and Geneva, Switzerland. Commenting on the new appointment, Dr. Zay Jeffries, Board chairman, said:

"In the next decade science and research will play an increasingly important role in our society. Dr. Thomas is well trained to lead Battelle to the new responsibilities and new opportunities which are ahead."

## Mobile Units for Missile Checkout

Moving vans, containing essential checkout equipment for missile electronic components, are being utilized in the U. S. Air Force's ballistic missiles program. These mobile units have been equipped by the Missile and Ordnance Systems Department of the General Electric Company (GE) as a part of its prime contract to develop the nose cones for the Atlas and Thor missiles.

Built 37 feet long and 9½ feet wide, by Watson Automotive Supply in Baltimore, Md., these GE vans are all fitted out with nose cone check-out systems as part of the tons of ground handling and launching equipment that must be left behind when a missile flies. These systems must be movable so that they can be conveyed right up to the launching pads.

Transportable either by rail or by prime mover, the vans contain 12 tons of air-conditioning, necessary for proper operation of the precision electronic equipment. Such massive equipment as this must be added to the dollies, cranes, block houses, gantries, and other ground-handling and launching necessities before a ballistic missile system is considered to be complete.

**NEAR THE END of this trailer's 37-foot length, a GE technician begins moving in necessary equipment. Overhead lights which are reflected in the end wall give an illusion of almost infinite length.**

*Wear Your ◆ AIEE Badge*

## U. S. and British Controlled-Fusion Research

In a series of releases from the U. S. Atomic Energy Commission (AEC) and the United Kingdom Atomic Energy Authority (UKAEA), background information has been supplied about the work being done by the Los Alamos and British groups which deal with electrical discharges carrying high momentary currents.

*American Papers.* The Los Alamos developments are presented in a series of papers that describe a number of advances made up to the present time.

The first paper deals with a method for determining the product of the temperature and the number of particles per unit volume. Because there are ways to get at the number of particles per unit volume, such measurements amount to a determination of the effective temperature of the hot gas. This technique, using measurements of the magnetic field in the gas, is fully described by L. C. Burkhardt, R. H. Lovberg, and J. A. Phillips.

The second paper, by D. C. Hagerman and J. W. Mather, describes the production of neutrons in a straight pinch tube. The apparatus, called Columbus II, began to yield significant results in the summer of 1957. Columbus II was designed to put electric power into the pinch tube in as short a time as possible. Under various conditions, the tube can be made to yield between 10 million and 100 million neutrons per pulse, and these are emitted in a time of about one millionth of a second, or less. In actuality, two currents—a small one and a large one—are applied, in succession.

Although there are some difficulties about stating temperature figures for any gas which carries substantial current, the temperatures computed by commonly used methods are several million degrees. More specifically, the situation in recent months is shown in the table which follows.

**Temperatures Computed by Commonly Used Methods**

| Tubes | Neutrons per Pulse (millions) | Conventional Temperature, C (millions) |
|---|---|---|
| Columbus II, straight | 10-100 | 5 |
| S-4, straight, larger | 0.01 | 3 |
| S-3, doughnut | 1 | 6 |

Elaborate tests were undertaken to determine whether most of the neutrons are produced by thermonuclear reactions, or whether they are emitted at the electrodes or walls, or from instabilities in the gas. The neutron yield increased by a factor of two when the voltage was raised from 40 to 50 kv. By catching the neutrons in very sensitive photographic plates placed around the discharge tube, it was possible to study whether their energy corresponds to a case in which the deuterons are moving in all directions or to a case in which they are moving with great speed toward the cathode. Actually, this is not a black-and-white situation. Both groups should be expected. It was found that there was a group of deuterons traveling toward the cathode with a speed of 70 million centimeters per second. Nevertheless, the results were encouraging because the neutrons are emitted from the gas and they come practically uniformly from all parts of the tube, except a region of 2 inches near positive electrode, where the yield is low.

The third paper, by L. C. Burkhardt and R. H. Lovberg, deals with a straight pinch tube called Columbus S-4, constructed to study the effects of greater length and greater tube diameter. The tube is a porcelain cylinder 5 inches in diameter and 24 inches long. It was shown that there can be circulating currents in the tube at certain times during the pinch process. There are indications that particle energies of 300 electron volts (or temperatures of about 3 million degrees) were attained, despite the fact that it was operated at voltages below 20 kv.

Perhaps the most significant observation with S-4 is that the field produced by the pinch current is highly reproducible over several half cycles of the applied voltage.

The fourth paper, by J. Honsaker, H. Karr, J. Osher, J. Phillips, and J. L. Tuck, describes the production of neutrons from a stabilized pinch in a small doughnut shaped tube, called Perhapsatron S-3. This tube came into operation in December 1957 and yields as many as a million neutrons per discharge, under suitable conditions. The main burst of neutrons occurs in a time of about 2 microseconds. Smaller bursts continue to occur for several additional microseconds. It is stated that the results are consistent with an effective temperature of about 6 million C.

*British Reports.* The British results with Zeta have been analyzed by L. Spitzer, Jr., professor of astronomy at Princeton University, and director of project Matterhorn. His analysis shows that the deuterons in Zeta must be accelerated to the observed high temperatures by some unknown process.

When a strong discharge is produced in deuterium gas, the deuterium atoms are split up into their component elements—electrons and deuterons. The electric voltages applied to the gas in Zeta would be expected to accelerate the electrons primarily. According to theoretical expectations, the accelerated electrons then impart their energy to the deuterons in elastic collisions, as between billiard balls. The analysis by Mr. Spitzer indicates that the rate at which deuterons can be accelerated by such collisions is too slow to explain the observed rate at which the deuterons in Zeta are accelerated to energies corresponding to several million degrees. Hence, some unknown process must be effective in Zeta.

Results obtained from the Harwell Zeta apparatus suggest that "thermonuclear neutrons" have been obtained, but further experiments will be necessary before this can be proved conclusively. Temperatures reached in this apparatus have been as high as 5 million C, higher than the measured surface temperatures of any star.

Many major problems have still to be solved before its practical application can be considered seriously and the work must be expected to remain in the research stage for many years. If ultimately it proves possible to construct a power station operating on the fusion of deuterium, the oceans of the world will provide a virtually inexhaustible source of fuel.

A large experimental apparatus for studying the controlled release of energy from thermonuclear reactions was started up at the Atomic Energy Research Establishment, Harwell, England, in the early part of August 1957. On August 30th, this apparatus was first operated under conditions that produced nuclear reactions; neutrons emitted in these reactions were observed when deuterium gas was heated electrically to temperatures in the region from 2 to 5 million C.

The high temperatures achieved, along with the relatively long duration for which the hot gas has been isolated from the tube walls, are the most important experimental results obtained so far. Much longer times (perhaps several seconds) are required for a useful power output. There appears to be no fundamental reason why these longer times, together with much higher temperatures, cannot be achieved.

As the UKAEA has stated in the last two annual reports, research has been in progress for some years to investigate the possibility of producing energy in a controlled manner from thermonuclear reactions. The reaction being studied in Zeta is that in which deuterons (nuclei of the heavy hydrogen isotope deuterium) collide with one another and fuse to form heavier nuclei, releasing energy and some neutrons in the process. For fusion to be possible, the deuterons must have enough energy to overcome the initial electrical forces of repulsion between them; this necessitates heating the deuterium gas to temperatures of millions of degrees centigrade. The hot gas must be kept away from the walls of the container, otherwise it falls in temperature.

In Zeta the discharge chamber is a ring-shaped tube or torus of 1 meter bore and 3 meters mean diameter, containing deuterium gas at low pressure. The tube is linked (i.e., encircled over part of its length) by the iron core of a large pulse transformer. A current pulse of electricity is passed into the primary winding of the transformer from a bank of capacitors capable of storing 500,000 joules of energy. This pulse in turn induces a very large unidirectional pulse of current in the gas, which forms a short-circuited secondary for the transformer. Peak currents up to 200,000 amperes have been passed through the ionized gas for periods up to 5 milliseconds. The current pulse is repeated every 10 seconds. Emission of neutrons throughout the current pulse is observed regularly in routine operation of Zeta with deuterium; there are up to 3 million neutrons emitted per pulse.

The temperature of gas discharges may be determined from measurements on the light emitted by the gas atoms but measurements of this kind in these experiments present problems because, at the temperature of the discharge, the hot deuterium atoms are completely stripped of their electrons and, therefore, do not emit a line spectrum.

*Other Developments.* Another group of British scientists at the nuclear research station at Aldermaston expect to achieve temperatures of 10 to 12 million C within a few months' time, in the Sceptre Three. In a larger model, now being designed, it is hoped that 30 to 40 million C will be reached by the end of 1958.

A similar conclusion, based on experimental results at Matterhorn in 1956, had been obtained by T. Stix, who developed the methods for comparing theory with observation. A temperature of 1.2 million C was obtained in a helium discharge, in a race-track tube 4 inches in diameter and 96 inches in axial length. Elastic collisions between electrons and the nuclei of helium atoms were definitely insufficient to account for the observed rate of heating.

This unknown process may be related to some of the complicated processes observed in conventional gas discharges. How this process behaves under different conditions may be of great importance in the design of a controlled thermonuclear reactor.

## Chemical Engineers Golden Jubilee Year

The American Institute of Chemical Engineers (AIChE) celebrated the start of its Golden Jubilee Year with the Founding Day ceremony on January 29, 1958, at the Engineers' Club in Philadelphia, Pa., where 50 years ago AIChE was born.

Greetings on behalf of the City of Philadelphia were sent by Mayor Richardson Dilworth to about 200 scientists and guests in attendance. Philadelphia will be the site of the Institute's Special Jubilee Convention during the week of June 22, 1958.

Highlight of the program was the presentation to the Engineers' Club of a plaque commemorating the founding of the Institute in 1908. The presentation was made by Dr. G. E. Holbrook, newly elected president of AIChE. J. G. Jackson, prominent patent attorney and past president of the Engineers' Club, accepted the plaque.

The week of April 14-18 has been designated as 1958 Chemical Progress Week.

## Research Information

The Research Information Committee of the American Institute of Industrial Engineers is starting to secure abstracts of research performed in the period from July 1, 1952, to July 1, 1957. Sources from which information will be solicited are universities, industrial organizations, research institutions, and nonprofit organizations, including Government agencies and professional societies. The information collecting program will provide a valuable service to industry and universities and especially to industrial engineers. Research abstracts are to be collected in the areas of: work measurement, methods, plant engineering, human engineering, engineering economics, organization planning, industrial statistics, production control, data processing, operations research, and cost analysis. The Committee will appreciate all information on Industrial Engineering research past and present, about which it might gather more specific details. Write to Research Information Committee, AIIE, Department of Industrial Engineering, Washington University, St. Louis 5, Mo.

## Clues to Antarctic Climate

The deep drilling project at the International Geophysical Year (IGY) Byrd Station in the Antarctic passed the 1,000-foot mark on January 26, 1958, the IGY Committee of the National Academy of Sciences has announced. Ice cores taken from this drill hole preserve in their annual layers clues to Antarctic climate reaching back many centuries.

The deep drilling program is being conducted for the IGY by personnel from the Army Snow, Ice, and Permafrost Research Establishment of the Corps of Engineers. Development of techniques and equipment for deep drilling to obtain undisturbed cores was inaugurated on the Greenland Ice cap.

A modified "Failing 1500" drill rig and specially designed core barrels and bits were used. Ice cuttings are removed from the drill hole by compressed air that has been specially cooled to the required temperature so that the core sample will not be melted. Extreme care must be taken to avoid shattering of the ice cores when they are removed from the great pressure which exists at depths over several hundred feet.

Equipment for the Byrd Station project was brought in by overland traverse from Little America, 647 miles away. Some equipment was dropped by parachute. The transport of this equipment represents a major achievement in the field of logistics.

Because of the relatively small annual accumulation of snow in the Antarctic, ice at 1,000 feet below the surface at Byrd Station is roughly equal in age to ice at the 2,000-foot level in Greenland. However, the Antarctic cores are more difficult to date because of a lack of refrozen summer melt as in Greenland where the age of a core can then be read as one reads the age of a tree by its annual rings. Careful chemical analysis may be needed to date the deep-lying cores.

The Byrd Station cores will be broken into 3-inch units for density measurements, visual examination, and determination of yearly accumulation whenever possible.

The microscopic examination and photography of thin sections of ice at different depths will permit studies of crystal structure and more accurate relation of age to depth and for study of the minute particles and primitive organisms that may have been trapped in the ice for hundreds of years.

A similar project is planned for the Ross Ice Shelf the latter part of 1958.

## Transistorized Counting System

An electronic counting system, which can total simultaneously the output of 40 different production, processing, or packaging operations has been announced available by the Radio Corporation of America (RCA). It is said that the multiple-source counting system, first of its kind, uses transistors throughout, a memory system, and high-speed electronic switching for lightning-fast counting of up to 120,000 units a minute.

First installation of the RCA electronic counting system is under way at the printing plant of *The Detroit News*, where it will be used to program press output of the newspaper's daily and Sunday editions. *The Detroit News* counting system, specially adapted for newspaper operations, is believed to be the first equipment capable of counting individual newspapers.

The system's high-speed counting capability stems largely from its built-in electronic memory system. Counting-signals from the detection devices are stored in the memory unit and then released in rapid sequence for totaling.

The newspaper-counter system will make it possible for a newspaper to obtain immediate, precise accounting of the output of each edition, to limit newspaper production to a specified number of copies and virtually eliminate wasteful and costly over-runs or premature press shut-downs.

The counter being installed is a 12-channel system which will record newspapers being carried from the press room on 11 different conveyors. One or more of the 11 newspaper conveyors can be totaled simultaneously. The 12th channel serves as a spare.

The detection device at the input section of each conveyor "senses" the folded edge of each newspaper and relays a signal to the remote master totalizer. The detection devices automatically compensate for day-to-day changes in number of newspaper pages.

As soon as the preset number of copies of an edition has been recorded, a signal is sent automatically to the press room superintendent to shut down the presses.

## Giant Snowflakes for Brussels World's Fair

An "icebox" that makes giant snowflake crystals is ready for the Brussels World's Fair this summer. It will be one of several exhibits from the United States.

The machine, which in 5 minutes makes giant crystals 2 to 4 inches across from supercooled water, is a product of the Division of Engineering and Applied Physics at Harvard University.

It allows the spectator to watch the process as crystals form. It also provides a new tool for research which may improve the quality of metals for many uses.

The Harvard device freezes water in a way quite unlike the kitchen refrigerator. In the usual freezing process, water is cooled to the freezing point, and the water remains at 32 F while it is freezing. The scientific "icebox" supercools water several degrees below the freezing point. Freezing does not begin until the tank is "seeded" by a tube which is cooled to a very low temperature at the appropriate time.

At this point, crystals begin to form in the water, looking, as one scientist put it, like "amphibious snowflakes." They grow very rapidly into long treelike structures called "dendritic crystals." The crystals are viewed by polarized light which shines through the tank from the back; a second layer of polarizing material between the crystals and the observer causes the growing ice crystals to appear colored. The colors produced run the gamut of the spectrum, shading into one another.

The usefulness of the "icebox" as a research tool lies in the similarity of dendritic crystals formed when the supercooled liquid metal in a casting solidifies. Because the process of formation of the crystals in metals largely determines the strength, toughness, hardness and brittleness of the metal, the formation of crystals in supercooled liquids is of great interest to metallurgists. Water was chosen instead of metal for an experimental subject because of its transparency.

The machine is part of the United States contribution to the International Science Exhibit which will be on display at the Brussels Fair for 6 months beginning this month. The unit has two tanks which operate simultaneously—cooling, freezing, and heating the water. The tanks are adjusted so that the freezing process will be continuously visible in one tank or the other.

## Motors Operate in High-Octane Fuel

A new test facility at the aircraft equipment department of the Westinghouse Electric Corporation at Lima, Ohio, evaluates the performance of aircraft fuel pump motors while submerged in high octane fuel under simulated conditions of altitude, heat, and cold.

Heart of the laboratory is the test room containing two tanks, each capable of testing separately two motor-pump combinations. Each tank has an upper and lower chamber separated by a steel plate having a 12- by 18-inch cutout. Motor-pump units to be tested are mounted in the top chamber on an adapter assembly that fits into this cutout. The top chamber of each tank can be flooded with 165 gallons of high-octane fuel and is equipped with coils to heat or cool the fuel as required.

During a test, the lower chamber is not flooded with the fuel but remains dry. A door on the bottom of this chamber allows access to the face of the pump for making power and thermocouple connections. This door is equipped with a suitable counterweight and is latched by eight swing-type ball handle bolts. A neoprene ring seals any gap between the lower chamber and door.

Both top and bottom chambers can be evacuated to pressures corresponding to an altitude of 65,000 feet. The high-octane fuel—up to 200 gallons per minute—is circulated by the pump, while the load on the motor is controlled by valves in the piping.

The metering room contains instruments for both indicating and recording flow, temperature, and pressure conditions throughout the system as well as the electrical characteristics of motors under test. All necessary controls and metering except valving are remote controlled by an operator in this room, who can view operations through a 3/4-inch thick explosionproof window in a connecting wall.

A dual motor-generator set in the auxiliary equipment room supplies 20 kva at 400-cycles a-c and 30 volts at 150-amperes d-c to the test facility. Two vacuum pumps are also housed in this room for evacuating the test tanks to simulate any altitude up to 65,000 feet. Multiple safety controls, among them automatic fuel dump valves, are included in the testing facilities.

## Summer Conferences, Seminars and Training Courses

*California Institute of Technology*. Three subjects will be covered the latter part of June. Of these, the session for Supervision of Engineers will be of interest to readers. The first schedule will be June 22-27. The repeat session will take place September 14-19. Further information on any of the conferences offered, including an outline of the program may be secured from: Management Development Center, California Institute of Technology, Pasadena, Calif.

*Polytechnic Institute of Brooklyn*. A series of eight international symposiums will be presented by the Microwave Research Institute April 8-10, in the auditorium of the Engineering Societies Building, 33 W. 39th St., New York, N. Y. Interaction of electromagnetic fields and electron or plasma beams in general waveguide regions will be covered.

*American Vacuum Society Inc*. The 5th National Vacuum Symposium will be held in San Francisco, Calif., October 22-24. The fields of fundamental research, applied research, industrial processes, and new and improved equipment for producing and measuring vacuum will be covered. Anyone who would like to submit a paper to be presented at the meeting are invited to contact W. G. Matheson, program chairman, 60 Boston St., Salem, Mass.

*The Pennsylvania State University*. Digital Design of Electrical Equipment is the title of a seminar which has been scheduled for June 22-27, at University Park, Pa.

*National Science Foundation*. Plans for a conference entitled "Research and Development and Its Impact on the Economy" to be held in Washington, D. C., were announced recently by A. T. Waterman, director of NSF. Additional information may be obtained from NSF by referring to NSF-58-105, National Science Foundation, Washington 25, D. C.

*Alwac Corporation*. A comprehensive schedule of Spring and Summer training courses in the use of electronic computer in business, industry, and scientific research has been prepared, some of which will cover such elementary needs as coding and simple programming. Others will be restricted to professors, teachers, instructors, and graduate students from colleges and universities because they are of a more advanced nature. Details of the courses are available from W. V. Crowley, Alwac Corporation, 13041 S. Cerise Ave., Hawthorne, Calif.

*Illinois Institute of Technology.* Application of Scientific Management Techniques to reduce industrial costs will be the theme of a conference to be held in Chicago, Ill., May 8-9. It will be held in the Metallurgical and Chemical Engineering Building, 10 W. 33rd St., and is sponsored by the Industrial Engineering Department and National Center for Education and Research in Dynamic Equipment Policy. Inquiries should be addressed to L. A. Wickstrom, IIT, Chicago 16, Ill.

*American Standards Association.* A Gaillard seminar on standardization will be headed by Dr. John Gaillard, management counsel. The 5-day session will be held in New York, N. Y., June 23-27. For details write to Dr. Gaillard, Box 273, Rte. 1, Briarcliff Manor, N. Y.

*U. S. Department of Labor.* Five areawide apprenticeship conferences have been scheduled by the Bureau of Apprenticeship and Training and State Apprenticeship Agencies. A 2-day session in St. Paul, Minn., May 1-2 has been completed by the Minnesota State Apprenticeship Conference. The Eastern Seaboard Apprenticeship Conference has selected the Griswold Hotel and Country Club, Groton, Conn., for its 14th Annual Meeting, June 23-26. The Marion Hotel, Little Rock, Ark., July 10-12, will be the scene of the 10 Annual Southern States Apprenticeship Conference. The National Railroad Apprenticeship Conference 2nd Annual Meeting will be held at the Statler Hotel, St. Louis, Mo., July 16-18. The Statler Hotel, Cleveland, Ohio, has been chosen as the site for the 8th Annual Ohio Apprenticeship Conference, September 8-10.

### Mystery Man Needs Identification

The puzzle of the pyramids is being challenged by a recently acquired painting of an electrical grandfather at the Burndy Library.

The painting has been submitted for identification to British and American authorities, all of whom have been unable to identify the personage in the picture.

The baffling part is the fact that obviously the gentleman is an important person in the electrical field, inasmuch as he is shown with a Leyden jar held in his left hand and a Henley electrometer in his right hand.

The Burndy Library, Norwalk, Conn., has turned to *Electrical Engineering* to help in solving this mystery. It is hoped that a reader may know the man as an ancestor, or be able to identify him by other means.

The portrait represents an early experimenter in the then newly established field of electrical science. His identity remains unknown. By publishing this portrait, it is hoped that it may lead to establishing the correct identity of the subject. The name of the artist, Thomas H. Gregg, appears in three different locations on the painting, but no clue is given or has been found as to who the sitter might be.

The signature at the bottom of this old painting reads: "Painted 1838. T. H. GREGG. Fitzroy Sq." This same name and address is repeated in the letter and envelope shown on the table. Pneumatic apparatus rests on the table at the left.

London sources have combed the records of the artist's exhibitions to no avail. They are still unable to identify the distinguished looking gentleman who sat for the portrait. The Institution of Electrical Engineers as well as the National Portrait Gallery (repository of famous personages of England) could not identify the sitter.

Might we in America find the clue to this early practitioner in electrical science?

The florid complexion, full features, youthful eyes framed with graying hair, seem to indicate a personage within the 38- to 50-year bracket. The proud manner in which he is shown holding these early electrical instruments should be an incentive to the vast progeny of electrical engineers of this honored forebear.

Can you identify this man? It is hoped that someone will be able to do that which has stymied authorities in the field. If anyone knows this man's identity, please contact Bern Dibner, Burndy Library, Norwalk, Conn., as well as *Electrical Engineering*, AIEE, 6th floor, 33 W. 39th St., New York, N. Y.

### Atoms Used for Sterilizing Sutures

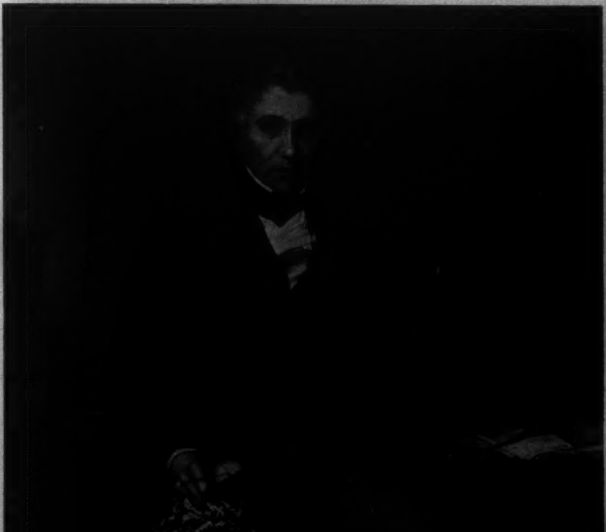
Atomic sterilization is a significant achievement in the field of peaceful uses of atomic energy.

The first items to come under the cleansing beams of electrons in a full-scale commercial operation were catgut sutures manufactured by Ethicon, a division of Johnson & Johnson, Somerville, N. J.

A switch was thrown that turned on the 7 million volts of electricity, sending electrons along a radar wave toward the sutures. The sutures were free of any contamination in a matter of a few seconds. Three prominent physicians reported in the *New York State Journal of Medicine* that electron beam sterilization of sutures means greater safety, faster healing, and less tissue reaction. The sterilized items are not made radioactive, it was emphasized.

The completely sealed tubes containing the sutures are bombarded by electrons

## Mystery Man



Courtesy Burndy Library

**WHO is this grandfather?**

as they pass under a greenish-blue light in a room lined with 7 feet of concrete. The electrons destroy all micro-organisms in or on the catgut by altering the molecular structure of the bacteria without changing the structure of the suture itself.

Heart of the apparatus is a vacuum tube about 8 feet long. The electrons are set in motion by a 50,000-volt filament at the top of the tube. A radar wave flows through the waveguide tube, pulsing about 800 times per second. The electrons are bunched in the top third of the tube, and ride the radar wave to the bottom. They gather speed on the way to the bottom until they are traveling at almost the speed of light. The electrons double in their mass at the bottom of the tube, but not in their size.

There are electromagnets at each side at the bottom of the tube which alternate the scan of the electron beam so that there is complete coverage of all of the suture containers on a tray over a period of several seconds as the tray slowly moves under the beam.

Electron-beam sterilization eliminates the heat and the aseptic handling because sterilization is accomplished after addition of the tubing fluid and the sealing of the tubes. This fact alone assures that the surgeon will have increased safety and reliability of the product.

This sterilization method is applicable to antibiotics, enzymes, and other pharmaceuticals which are sensitive to heat and cannot be sterilized by chemical means.

## Electric Cable Steers Automobile

An automatically guided automobile cruised along a one-mile stretch of road at the General Motors Technical Center recently. It was steered by nothing but an electric cable beneath the concrete of the check road.

It was the first demonstration of its kind with a full-size passenger car, indicating the possibility of a built-in guidance system for tomorrow's highways.

The demonstration car was a 1958 Chevrolet which was guided by a combined electronic computer and a servomechanism system which takes over human steering control by following a magnetic path produced by low-frequency power in the subsurface highway cable.

The car rolled along the two-lane check road and negotiated the banked turnaround loops at either end without the driver's hands on the steering wheel. To turn off the road or to pass another vehicle, the driver merely touched a switch on the steering gear which cut back into the manual steering system.

Although the new system is still only in the experimental stage, it is the first "building block" for a future system of highways with controlling vehicle spacing, detecting location of cars, and giving drivers signals for throttles and brakes.

Low-frequency alternating current in the highway cable creates a circular magnetic field that extends the length of the cable, similar to a very short-range radar beam.

On the front bumper of the test car is a pair of tuned pick-up coils which straddle the cable's magnetic field. As the car follows the magnetic path, the voltage across the terminals of the pick-up coils depends upon the magnetic field strength. Any deviation or lateral motion of the car causes a difference in voltage from one pick-up coil to the other.

These voltage variations feed into a small electronic analog computer on the instrument panel which, in turn, is linked with a servo system that controls the car's modified power steering unit. In effect, the computer measures the difference in voltage and automatically adjusts the steering onto the magnetic path through the servomechanism system. The computer puts out "command" signals to the servomechanism which positions the front wheels. Thus, if the car undergoes any rolling, sideslipping, or yawing motion, the automatic steering system brings it back into the straight-ahead path.

It is felt that the system can be integrated very easily into the existing highway network across the country, possibly in the form of a separate "automatic" lane for those cars equipped with the proper device.

## Space Sentry Aids Explorer Satellite Tracking

The "Space Sentry," a giant new radio transmitter of the U. S. Army Signal Corps, bounced signals from the moon to insure close tracking of the Army's Explorer and other United States satellites which may be projected, the Department of Defense has announced.

The calibration tests, which began January 14, 1958, and ended January 28, assured that Minitrack listening posts throughout the Western Hemisphere and on the west coast of Africa would be tuned precisely to the same frequency—in effect that their "watches would be synchronized." In addition, the tests were used to check the internal computing systems of the Minitrack stations. These operations are vital for co-ordinated observation of the satellites.

The tests were conducted on even days of the month. The signals were transmitted from Fort Monmouth, N. J., to the moon on each test date for 5 hours. This period, between moonrise and moonset, bracketed the moment when the moon was at the same longitude as the station sits.

The Space Sentry was erected by the U. S. Army Signal Engineering Laboratories at Fort Monmouth in co-operation with the Naval Research Laboratory, Washington, D. C.

The transmitter's signal is fed to a 50-foot dish-shaped antenna. This equipment is a modification of radar Diana, which made man's first contact with the moon in 1946.

By use of the highly directional antenna, the transmitter power is packed into a narrow beam equal to a million and a half watts. This lightning-jolt signal is millions of times more powerful than that of the miniature transmitters in the Army's Explorer.

Space Sentry operates on a frequency of 108 mc. the same spot in the radio-frequency spectrum assigned to United States satellites. In addition to the Minitrack stations, amateur radio operators co-operating with the satellite effort were tuned to the moon-bounce signals.

Before the new transmitter was installed, Diana was used to establish the feasibility of the unique method for aligning the satellite receiving and computing equipment. This was done by temporarily modifying some of the Minitrack equipment at Blossom Point, Md., to the previous 151-mc frequency of Diana's transmitter. The Space Sentry itself is not a satellite tracker, but beams its signal to the moon before each space vehicle goes up.

An important part of calibrating the tracking receivers is trial measurement of the Doppler shift in radio frequency. As a satellite passes overhead, the frequency of its moving transmitter seems to change, just as a locomotive whistle or horn apparently drops in pitch as a train passes. This frequency shift tells scientists the speed and direction of the satellite.

Each Minitrack receiver, which has a fixed narrow-beam antenna covering an allotted sector of the sky, receives the moon-bounce signals for only an hour during a 5-hour test period as its position changes in relation to the moon.

Army–Navy co-operation on the Space Sentry saved both time and public funds in the satellite program. The transmitter was supplied and installed under Navy contract by John H. Mullaney, a Washington, D. C., firm of consulting radio engineers.

## Automated History Book

An electronic outline of world history from 4 B. C. to the present was demonstrated by International Business Machines Corporation (IBM) in co-operation with the U. S. Department of State. The automated history text is stored in 10 languages—including Russian—in an IBM *305* Ramac computer. Any portion of the history may be located by Ramac in less than two thirds of a second and printed out in any one of the 10 languages on a built-in IBM electric typewriter.

The Ramac "history book" will be a feature exhibit in the U. S. Pavilion at the Brussels World's Fair. H. S. Cullman, U. S. Commissioner-General to the Fair, recently told reporters: "The sponsorship by industry—on a noncommercial basis—of many exhibits for the U. S. Pavilion is instrumental in presenting a true and clear picture of America to millions of non-Americans. The way in which United States firms are responding to this co-operative challenge is a splendid example of American ingenuity and versatility."

M. B. Smith, assistant general manager of IBM's Data Processing Division, stated: "IBM welcomes the opportunity to demonstrate the use of automation and electronics to a world-wide audience. We hope to show peoples of all nations that automation is the servant not only of America, but also of the entire world."

The Ramac historical file was demonstrated by Dr. C. C. Hurd, IBM's director of automation research. Dr. Hurd invited reporters to call at random various dates in history. The Ramac operator entered the years on the Ramac keyboard, and in less than a second an IBM electric typewriter began printing out a concise statement of the major events of the particular year in question. Examples: "1480—Leonardo da Vinci invented the parachute. Dr. Johann Faustus, necromancer, was born in Germany: 1766—Mozart composed his first opera at the age of 11. Christian VII became King of Denmark." A special television camera displayed such examples on a monitor screen. Historical events in the Ramac storehouse ranged from the birth of Christ to the launching of Sputnik I.

At the request of reporters, the Ramac operator pressed special keys to print out the history text in any one of eight languages. The languages were English, French, Italian, Nederlands, Spanish, Swedish, Portuguese, and German. Russian and Interlingua (a universal scientific language) will be available on the Ramac being built in the new IBM plant at San Jose, Calif., especially for the Fair. This computer will be shipped to Brussels by cargo plane over the polar route in time for the opening of the Fair on April 17.

The memory section of the IBM *305* Ramac consists of a stack of record disks which revolve on a vertical shaft at 1,200 rpm. An electronically controlled arm moves to any one location on the records to recover the historical information, which is stored on the records in the form of magnetized spots. It took the arm no more than two thirds of a second to find any of the information requested by reporters.

The Ramac unit contains up to 5 million alpha-numeric characters, Dr. Hurd pointed out. He added that there was enough space left in the machine's memory to show how it can keep track of thousands of items in a huge warehouse. To prove the point, the machine handled a complicated transaction involving a mythical hardware company, updating all the company's records which were affected by the transaction. To do this, Ramac adjusted and determined stock balances, signalled inventory shortages and out-of-stock items, applied prices and calculated charges, determined credit ratings, looked up previous balances, and printed a complete customer invoice—all in one continuous automatic process lasting less than 30 seconds.

The Ramac history file is a unique work of many scholars, researchers, and translators. More than 50 sources were consulted by the researchers, and from these a working bibliography of 21 books and manuscripts was chosen. Many difficulties were overcome during the preparation of the data. Of some years, particularly those prior to the Renaissance, there was almost no record in existing chronologies.

## AEC Gamma Irradiation Service Discontinued

As of March 31, 1958, the Atomic Energy Commission (AEC) will not accept new requests for gamma irradiation service from the public when the requested service is readily available commercially.

A recent AEC survey shows that at least 16 academic and industrial organizations are prepared to provide gamma irradiation service on a commercial basis. This number is believed to be large enough to assure service at reasonable prices. The AEC has decided, therefore, to discontinue the service in line with its general policy of furnishing materials and services only when they are not reasonably available commercially.

Advance notice of the decision is given to allow time for organizations offering the service and their potential customers to work out satisfactory arrangements. The AEC will continue to provide irradiation service to Federal agencies as necessary.

A number of organizations having facilities capable of handling more than 1,000 curies of cobalt-60 are shown by the AEC survey to be willing to perform irradiation service for others.

A list of these facilities showing the gamma flux available, the number and size of samples which can be accommodated, and the approximate amount of space available may be obtained from the Office of Industrial Development, Atomic Energy Commission, Washington 25, D. C.

# LETTERS TO THE EDITOR

**INSTITUTE members and subscribers are invited to contribute to these columns expressions of opinion dealing with published articles, technical papers, or other subjects of general professional interest. While endeavoring to publish as many letters as possible, *Electrical Engineering* reserves the right to publish them in whole or in part or to reject them entirely. Statements in letters are expressly understood to be made by the writers. Publication here in no wise constitutes endorsement or recognition by the AIEE. All letters submitted for publication should be typewritten, double-spaced, not carbon copies. Illustrations should be submitted in duplicate, one copy and inked drawing without lettering, the other lettered. Captions should be supplied for all illustrations.**

## Low-Sound Enclosures

*To the Editor:*

The construction of sound deadening enclosures described in *Electrical Engineering,* January 1958, p. 113, is interesting and reminiscent of work on the same problem carried out in this country many years ago[1] resulting in a similar constructional solution.

The method was then perhaps more obvious and certainly easier to adapt to existing installations since it has been a general practice among British manufacturers for many years to employ separate banks of cooling radiators on all the larger transformers. This was not done originally for sound installation purposes but because of the better self-cooling conditions due to the extra height of the radiators above the windings and the greater flexibility in utilizing insulation space, as the radiator banks could be erected in the most convenient position in relation to the transformer.

As an example, a 30-mva OA/FOA 3-phase 132/11-kv Ferranti transformer with load ratio control was installed in 1930 and the sound insulation added on site in 1933. An audio sound-level reduction of 16 db was obtained.

A more modern construction on this principle has been standardized by the British Central Electricity Authority and described at the CIGRE Conference in 1956.[2] The standard form of transfomer construction is retained but with extended bushing turrets leaving the transformer as far as practical in a vertical or horizontal plane. The cost of this simplified construction is approximately 3% of the transformer cost. It is thus a very economical means of obtaining a noise reduction of 15 to 20 db. Complete enclosures would cost probably 20 to 25% for little further improvement.

Yours truly,

E. T. NORRIS (F '30)

(Consulting Engineer)

## Orderly Creative Inventing

*To the Editor:*

The article in the October 1957 issue of *Electrical Engineering* entitled "Orderly Creative Inventing," by W. H. Middendorf and G. T. Brown, Jr., contains a method of invention quite similar to one of two methods which are contained in a book-length manuscript which I wrote in the spring of 1955, entitled "Creative Method for Invention and Prediction." The manuscript has been submitted unsuccessfully to several publishing houses.

The steps given in this manuscript are based on a theory of structure and form which is developed by the author. The methods can be shown to be an extension of the methods given by Francis Bacon.[1] By use of the methods, invention becomes a matter of routine, although not an easy matter to achieve. I have used them with success for the past 2 years, and can attest to their value for creation of both abstract ideas and concrete devices. Invention is not complete at this point, since only the conception is achieved; but once the idea is grasped, the reduction to practice can be made by the usual methods of logical analysis where applicable, and most important for really new ideas, by

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1. "Noise in Power Transformers," E. T. Norris, *The Engineer* May 5, 1933, p. 155

2. "Transformer Noise Limitation," C. M. Brownsey, I. Glover, and G. B. Harper Paper No. 108, CIGRE, Paris 1956

experimentation to determine validity of the new concepts.

L. W. ALLEN

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1. Novum Organon (book), Bacon, Francis. Translation by G. W. Kitchin. Oxford Press, Oxford, England, 1855.

## Unified-Theory Dimensions

*To the Editor:*

In regard to L. W. Allen's article entitled "Dimensions for a Unified Theory of Electromechanics" which appeared in your February 1958 issue, I would like to point out that the derivation of his dimensional set $\sqrt{F}, L, T$ is based on the *assumption* of a dimensionless permittivity.

The argument for using $\sqrt{F}$ as a fundamental dimension rests on the validity of equation 3.

$$F = Q E + \frac{1}{2} r^3 \frac{k-1}{k+2} \text{grad } E^2$$

taken from Abraham and Becker. The last term of this equation is developed in Abraham and Becker from an expression for dipole moment

$$M = a^3 \frac{k-1}{k+2} E$$

which in turn is derived from the more basic relationship $M = ER^3$.

The derivation of $M = ER^3$ (page 69, Abraham and Becker) is dependent on the relationship

$$E = \frac{Q}{r^2}$$

(page 56), which in turn is derived from the fundamental Coulomb force equation

$$F_1 = \frac{Q_1 Q_2}{r^2} f$$

($f$ being a function of permittivity) and the defining equation $F_1 = Q_1 E_2$. Equating these last two there is obtained

$$E_2 = \frac{Q_2 f}{r^2} \quad \text{or} \quad E = \frac{Q f}{r^2}$$

and differs from the equation of page 56 by the factor of $f$. This factor $f$ has a numerical value equal to unity because Abraham and Becker (page 55) choose the absolute electrostatic system of units for use in the text.

The text does not carry $f$ in any of the further equations developed, thereby assuming that $f$ is not only equal to unity, but is also dimensionless. This is, therefore, assuming that permittivity is dimensionless. It is a matter of consequence, then, that L. W. Allen's dimensional set comes out such that the dimension of the dielectric constant is unity, $V^2 = F$, and $Q = \sqrt{F} L$. Maxwell's derivation of $Q = \sqrt{F} L$ (as mentioned in article) is based on the same assumption of dimensionless permittivity.

**Table I. Dimensions of Electrical Quantities in Terms of $\sqrt{F}$, L, T**

| Symbol | Name | Dimension (for $k=1$) | (for $\mu=1$) |
|---|---|---|---|
| $V$ | Voltage | $\sqrt{F}$ | $\frac{\sqrt{F} L}{T}$ |
| $E$ | Electric intensity | $\frac{\sqrt{F}}{L}$ | $\frac{\sqrt{F}}{T}$ |
| $Q$ | Charge | $\sqrt{F} L$ | $\sqrt{F} T$ |
| $B$ | Magnetic flux density | $\frac{\sqrt{F} T}{L^2}$ | $\frac{\sqrt{F}}{L}$ |
| $k$ | Permittivity | 1 | $\frac{T^2}{L^2}$ |
| $\rho$ | Volume charge density | $\frac{\sqrt{F}}{L^3}$ | $\frac{\sqrt{F} T}{L^3}$ |
| $D$ | Electric flux density | $\frac{\sqrt{F}}{L}$ | $\frac{\sqrt{F} T}{L^2}$ |
| $H$ | Magnetic intensity | $\frac{\sqrt{F}}{T}$ | $\frac{\sqrt{F}}{L}$ |
| $I$ | Current | $\frac{\sqrt{F} L}{T}$ | $\sqrt{F}$ |
| $\mu$ | Permeability | $\frac{T^2}{L^2}$ | 1 |
| $R$ | Resistance | $\frac{T}{L}$ | $\frac{L}{T}$ |
| $\mathcal{L}$ | Inductance | $\frac{T^2}{L}$ | $L$ |
| $C$ | Capacitance | $L$ | $\frac{T^2}{L}$ |
| $M$ | Dipole moment | $\sqrt{F} L^2$ | $\sqrt{F} T L$ |
| $P$ | Polarization | $\frac{\sqrt{F}}{L}$ | $\frac{\sqrt{F} T}{L^2}$ |

Since the basic number of independent electromechanical dimensions is four (usually $Q$, $L$, $M$, $T$), one new electrical or mechanical relationship will allow any one of these dimensions to be eliminated. Any assumed relationship will work the same as an actual one and there is obviously an infinite number of ways to do this. The three-dimensional set in the article was obtained by assuming permittivity $k$ as being dimensionless. Another three-dimensional set may be obtained by assuming permeability $\mu$ as being dimensionless. Taking the same three dimensions ($\sqrt{F}$, $L$, $T$) as basic, the results are tabulated in Table I along with the results of L. W. Allen's article. The dual nature of many of the electrical quantities is apparent.

Very truly yours,

R. A. HOMAN (AM '48)

# NEW BOOKS

**The following new books are among those recently received at the Engineering Societies Library. Unless otherwise specified, books listed have been presented by the publishers. The Institute assumes no responsibility for statements made in the following summaries, information for which is taken from the prefaces of the books in question.**

DAVISON'S TEXTILE BLUE BOOK. 92nd Year Handy Edition. Davison Publishing Co., Ridgewood, N.J., 1957. 1251 pages, 5 by 8¼ inches, bound. $7.25. This standard guide to the textile industry lists manufacturers of cotton, woolen, worsted, carpet, rayon, silk, and synthetic fabrics, giving principal officers, capitalization, number and types of machines, number of employees, and specialties. It also contains information on knit goods mills, dyers and finishers, associations, schools, etc. The main lists are geographical, with indexes by mills, dyers, and raw cotton firms.

ADVANCES IN ELECTRONICS AND ELECTRON PHYSICS, VOLUME IX. Edited by L. Marton. Academic Press, Inc., 111 Fifth Ave., New York 3, N.Y., 1957. 347 pages, 6 by 9¼ inches, bound. $9. The present volume centers about the International Geophysical Year and attempts to acquaint geophysicists with some of the electronic methods at their disposal. Studies are presented on the aurora borealis, negative ions, radio observation of meteors, intensity variations in cosmic rays, radio wave propagation, electronics in oceanography, and contributions of electronics to seismology and geomagnetism.

ATMOSPHERIC ELECTRICITY. By J. A. Chalmers. Pergamon Press, Inc., 122 E. 55th St., New York 22, N.Y., 1957. 327 pages, 5½ by 8¾ inches, bound. $10. Provides an account of the phenomena of atmospheric electricity, including that of fine weather as well as disturbed weather and thunderstorms. The book covers many recent advances in the subject and proceeds on the assumption that the reader has little knowledge concerning it. Areas studied are the earth's vertical potential gradient, conductivity of the air, air–earth conduction current, point discharge and precipitation currents, transfer of charge, the thundercloud, lightning discharge, and separation of charge.

BASIC ELECTRIC CIRCUIT THEORY. By W. W. Lewis. The Ronald Press Company, 15 E. 26th St., New York 19, N.Y., 1958. 650 pages, 6¼ by 9¼ inches, bound. $9. A fundamental approach to electric circuits is presented in two sections. The first section covers the basic principles for the solution of circuits and discusses instantaneous power, series and parallel resonance, loci, coupling, mutual inductance, and the solution of polyphase circuits. The second section covers secondary principles and applications including the solution of Laplace transforms and the use of hyperbolic and exponential functions for the solution of transients, filters, and transmission lines.

BRITISH ELECTRICAL POWER CONVENTION: PROCEEDINGS OF THE NINTH CONVENTION, 1957. Published by The Convention, London, England, 1957. 814 pages, 5¾ by 8¾ inches, bound. Price not given. The theme of the papers presented is that of electricity in the British economy. Individual sections deal with power generation, transmission distribution, industrial utilization of electricity, and home consumption of electricity. Although the main emphasis is on the economic aspects of power generation, technological developments are studied at length.

DIGITAL COMPUTER COMPONENTS AND CIRCUITS. By R. K. Richards. D. Van Nostrand Company, Inc., 120 Alexander St., Princeton, N.J., 1957. 511 pages, 6 by 9¼ inches, bound. $10.75. This basic text for the student or practicing engineer emphasizes basic engineering approaches to digital techniques. A wide range of components and circuits of an experimental nature is covered, as well as logical functions and digital storage, basic operations to be performed by a digital computer, and the advantages and disadvantages of various approaches to design. Design concepts are stressed rather than specific design details.

**DRY-BATTERY RECEIVERS WITH MINIATURE VALVES.** By E. Rodenhuis. Philips Technical Library, Eindhoven, Netherlands, 1957. 240 pages, 6 by 8¾ inches, bound. $4.95. Covers the field of receivers using directly heated tubes. Both design and servicing data are provided in such areas as current supply, characteristics of miniature tubes for dry-battery operation, and eight typical circuits. Each circuit is studied in considerable detail and sensitivity valves for nominal and reduced supply voltages are included so that a complete picture of what to expect may be obtained. Special circuits include a highly sensitive receiver for remote regions. an AM–FM receiver and a push–pull output stage.

**ELEKTRONENRÖHREN.** By M. J. O. Strutt. Springer-Verlag, Berlin, Germany, 1957. 391 pages, 6¾ by 10 inches, bound. DM 58.50. This completely revised edition, published formerly under the title "Moderne Mehrgitterelektronenröhren," covers the subject of electron tubes under three major sections: electrophysical and technical fundamentals, electron guiding by means of electromagnetic fields, and properties and other data concerning electron tubes used in industry. Within the framework of these headings, the author provides a comprehensive coverage of all major aspects both theoretical and practical. The volume is the third in the series "Lehrbuch der Drahtlosen Nachrichtentechnik."

**ELSEVIER'S DICTIONARY OF ELECTRONICS AND WAVEGUIDES IN SIX LANGUAGES.** Compiled by W. E. Clason. D. Van Nostrand Company, Inc., 120 Alexander St., Princeton, New Jersey, 1957. 628 pages, 6¼ by 9 inches, bound. $17.50. Contains terms which relate to electronic engineering rather than to physical electronics. Over 2,000 words are defined in English according to the most precise international standard available. Corresponding terms then appear in French, Spanish, Italian, Dutch, and German arranged in a horizontal fashion. An index to the foreign term provides access to the related English term and its definition.

**ENGINEERING MATERIALS HANDBOOK.** Edited by C. L. Mantell. McGraw-Hill Book Company, Inc., 330 W. 42nd St., New York 36, N.Y., 1958. Various pagings, 6¼ by 9¼ inches, bound. $21.50. A very thorough reference book that emphasizes fabricated forms of materials, their physical and mechanical properties, their advantages and limitations, protection against deterioration, and increase in their stability to withstand use and abuse. The subject matter is divided into four parts: metals, inorganic materials, organic materials, and the prevention of failure. A feature of the book is the attention given to uncommon metals.

**HOCHDRUCK-HEISSDAMPF.** By R. Doležal. Vulkan-Verlag, Dr. W. Classen, Essen, Germany, 1957. 338 pages, 6¾ by 9½ inches, bound. Price not given. A text on high-pressure, superheated steam which reviews German, American, Soviet, and Czech experience in the field. Major topics covered are: materials problems in a superheat installation; phenomena during the production of saturated steam; behavior of steam in the superheater; control of steam purity; the superheater, its accessories, and its protection during start-up; effect of plant conditions on superheat temperature; and the influence of changes in temperature on the life of superheater coils.

**HUMAN RELATIONS IN INDUSTRIAL RESEARCH MANAGEMENT.** Edited by R. T. Livingston and S. H. Milberg. Columbia University Press, 2960 Broadway, New York 27, N.Y., 1957. 418 pages, 5¾ by 8¾ inches, bound. $8.50. A 5-part collection of 27 papers from the 1955 and 1956 Industrial Research Conferences sponsored by Columbia University. The papers are directed at two audiences—people in individual research, and people studying the management of research. Part 1 deals with the expectations and jobs of research; part 2, the individual and the research job; part 3, research organization and the management jobs; part 4, some aspects of human relations; and part 5, managerial technologies.

**MANUFACTURING MANAGEMENT.** By F. G. Moore. Revised Edition. Richard D. Irwin, Inc., Homewood, Ill., 1958. 843 pages, 6 by 9¼ inches, bound. $8.35. In the revised edition of this comprehensive text, increased emphasis has been placed on capital expenditures, cost control, operations research, and linear programming. Also included is a realistic appraisal of the advantages and disadvantages of computers. Case studies have been incorporated into the text rather than at the end of the book as in the previous edition.

**MATERIALS HANDLING HANDBOOK.** Edited by H. A. Bolz. The Ronald Press Company, 15 E. 26th St., New York 10, N.Y., 1958. Various pagings, 6¼ by 9¼ inches, bound. $20. Concerned with efficient and economic handling of materials in raw, in-process, or finished form. Methods for analyzing handling problems are treated: principles and techniques for effective operation and control; systems design and installation; integration of materials handling activities with the manufacturing processes; and the design, selection, and classification of materials handling equipment. This equipment is analyzed in relation to the engineering specifications and the operating capabilities of each type.

**METHODS FOR EMISSION SPECTROCHEMICAL ANALYSIS.** Published by The American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., 1957. 488 pages, 6 by 9¼ inches, bound. $7. Spectrochemical analysis of the most important ferrous and nonferrous metals and alloys are covered, as well as several nonmetallic materials such as glass, ceramics, slags, and petroleum products. Suggested practices are included on the installation and safe operation of a laboratory, specifying excitation sources, designating shapes and sizes of electrodes, sampling and computations. In addition to the suggested practices and methods there are recommended practices and methods with pertinent information to permit application in various laboratories with different types of equipment.

**NATIONAL ELECTRICAL CODE HANDBOOK.** By A. L. Abbott. Ninth Edition revised by C. L. Smith. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N.Y., 1957. 650 pages, 5¾ by 8¼ inches, bound. $8. A guide for the user of the Code, this manual is designed to promote better electrical installations in the interest of safety to persons and property. It contains basic minimum requirements for installations in general, for those involving special occupancies, special equipment, or other unusual conditions, and for installations of communications systems. A separate chapter is devoted to construction specifications. The arrangement follows the numbering system of the 1956 Code, and includes explanations of Code rulings.

**NATIONAL FIRE CODES.** Volume 5, Electrical. Revised to July 1957. Published by the National Fire Protection Association, 60 Batterymarch St., Boston 10, Mass., 1957. Various pagings, 5½ by 8¾ inches, bound. Volume 5, $6; entire set of six volumes, $30. The text of the National Electrical Code. giving in their latest form minimum provisions considered necessary for safety for wiring design, materials, and methods, and for electrical equipment for all types of installations in many locations. The volume is one of six covering respectively, flammable liquids and gases; combustible solids, dusts, chemicals, and explosives; building construction and equipment; extinguishing equipment; electrical (noted); transportation; and miscellaneous.

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**ONCE ROUND THE SUN: THE STORY OF THE INTERNATIONAL GEOPHYSICAL YEAR.** By Ronald Fraser. The Macmillan Company, 60 Fifth Ave., New York 11, N.Y., 1957. 160 pages, 5½ by 8½ inches, bound. $3.95. Because of the importance of the sun in the study of geophysics, various phases of the sun's behavior are discussed and its effect on the earth, including earthquakes, terrestrial magnetism, the movements of the oceans and the great air masses, the auroras, and the melting of glaciers. The program of the IGY is covered in detail: the 24-hour watch on the sun, the oceanographic program and the concentration of stations throughout the earth. A two-page conclusion is a summary of what the program hopes to achieve.

**PROGRESS IN NUCLEAR PHYSICS, VOLUME 6.** Edited by O. R. Frisch. Pergamon Press, 122 E. 55th St., New York 22, N.Y., 1957. 297 pages, 6¼ by 10 inches, bound. $14. Provides a survey of current research activities within the field of nuclear physics. Of the nine articles presented, almost half are devoted to isotopes and the remainder deal with nuclear models, nuclear moments and spins, spectroscopy of mesonic atoms, fission recoil and its effects, and parity nonconservation in weak interactions. Useful features are the table of contents preceding and the extensive bibliography following each paper.

**TECHNICAL REPORT WRITING.** By J. W. Souther. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y., 1957. 70 pages, 8¼ by 10¾ inches, paper. $2.95. A concise, practical treatment which approaches the subject as a design problem, and which relates report form to the use to be made of the report. The major aspects of the subject are taken up in a logical manner: determining the purpose, industrial use and audience of the report; gathering the necessary material and evaluating it; the problem of deciding what material is to be included and the order in which it is to be presented; and writing the report, including preparation of the final copy.

**TECHNIQUES OF MAGNETIC RECORDING.** By Joel Tall. The Macmillan Company, 60 Fifth Ave., New York 11, N.Y., 1958. 472 pages, 5½ by 8½ inches, bound. $7.95. After an historical introduction to the development of magnetic recording, information is provided on technical aspects such as recording media. drive mechanisms, erasing, recording procedures, and spurious printing. Considerable attention is given to the techniques employed in its use, particularly in relation to radio, motion pictures and television, medicine, and education.

**THEORIE SCHALLNAHER STRÖMUNGEN.** By K. G. Guderley. Springer-Verlag, Berlin, Germany, 1957. 376 pages, 6½ by 9¼ inches, bound. DM 42. This text presents, for the first time, an extensive treatment of the theory of transonic flow, demonstrating the interrelation between the mathematical and the physical approach. The author's aim is to explain the mathematical methods and theoretical results to the aerodynamics engineer and, at the same time, to give the applied mathematician an indication of the mathematical problems arising from the physical conditions.

**VAN NOSTRAND'S SCIENTIFIC ENCYCLOPEDIA.** Third Edition. D. Van Nostrand Company, Inc., 120 Alexander St., Princeton, N.J., 1958. 1,839 pages, 8¾ by 11¼ inches, bound. $30. Considerably revised, this comprehensive reference work presents some 15,000 separate topics dealing with principles and applications of the physical sciences, medicine, and technology, including nuclear science and engineering. The presentation of each topic, beginning with a simple nontechnical definition and progressing to the more advanced phases, is helpful to the general reader. In addition to the customary cross-references, all terms in the main alphabetical list are printed in heavy type wherever they occur.

**X-RAY CRYSTAL STRUCTURE.** By Dan McLachlan, Jr., McGraw-Hill Book Company, 330 W. 42nd St., New York 36, N.Y., 1957. 416 pages, 6¼ by 9¼ inches, bound. $15. Shows how to determine the atomic positions within a crystalline material, using X-ray data obtained from single crystals. The theory of space groups, single crystal cameras, Fourier methods, computing devices, and the phase problem are presented in detail. In addition, computing devices such as Robertson's strip methods, the Bragg-Huggins mask, the sand machine, and the Utah computer are described. In general, theoretical aspects are combined with practical applications in order to provide an intermediate approach to X-ray crystallography.

THE FOCAL ENCYCLOPEDIA OF PHOTOGRAPHY. Published by The Macmillan Company, 60 Fifth Ave., New York 11, N. Y., 1956. 1,298 pages, 7 by 9½ inches, bound. $20. Some 200 authors, mostly British, have written the many articles which encompass techniques, art, and the business of photography and its adjoining and related technologies—cinematography, photomechanical processes and others. Emphasis is placed on subjects of wide general interest, and data, formulas, and working instructions are well detailed to enable the reader to base practical work or more advanced study on them. Information on scientific applications of photography, its industrial, commercial, and legal aspects, is given to the extent to which it can be useful to the nonspecialist.

# TECHNICAL LITERATURE

**The following recently issued technical literature may be of interest to readers of *Electrical Engineering*. All inquiries should be addressed to the issuers.**

PROTECTION AGAINST NEUTRON RADIATION UP TO 30 MILLION ELECTRON VOLTS. National Bureau of Standards Handbook 63, issued November 22, 1957, 88 pages, is available at 40¢ from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. (See *Electrical Engineering*, Feb. 1958, page 194.)

POWER REACTOR TECHNOLOGY. Issued quarterly by the U. S. Atomic Energy Commission (AEC), this new journal summarizes and evaluates current developments in power reactor technology, reporting on both research and development results applicable to reactors generally and progress made with specific reactor types. The quarterly may be purchased by subscription at $2 (foreign $2.50) or by individual issue at 55¢ from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

PROCEEDINGS OF THE 13TH ANNUAL MEETING (1957) OF THE METAL POWDER ASSOCIATION. Detailed information on new developments in powder metallurgy is available for the first time in this two-volume report. Volume I covers all phases of the industry, including production techniques, new machinery, and novel applications for metal powders. Complete transcriptions of all individual papers, symposia, and panel discussions are included. Volume II is devoted to special problems of ferrites and electronic cores. Copies of the "Proceedings" may be obtained from the Metal Powder Association, 130 W. 42nd St., New York 36, New York. Volume I, General Session on Powder Metallurgy, is $4 and Volume II, Ferrites and Electronic Core Session, is $3. Each volume is available individually.

DESIGN OF FREE-AIR IONIZATION CHAMBERS. By H. O. Wyckoff and F. H. Attix, this publication, issued by the National Bureau of Standards (NBS), presents general design characteristics for standard free-air type ionization chambers for X rays from 50 to 500 kv. A discussion of the general characteristics of all free-air chambers is included, as well as a section covering the details of chamber design. To test the over-all adequacy of the data contained in the handbook, and to provide a guide for its use, the Swedish portable chamber is calibrated with the NBS standard as an example. The accuracy of free-air chamber measurements is given in a table which lists the estimated maximum error for each experimental factor. A list of further references is included. The 16 page handbook, number 64, was issued December 13, 1957 and is available at 20¢ from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. (Foreign remittances must be in U. S. exchange and should include an additional one fourth of the publication price to cover mailing costs.)

THE MATERIALS HANDLING HANDBOOK. Edited by H. A. Bolz and G. E. Hagemann, this reference work was prepared under the sponsorship of the American Material Handling Society (AMHS) and the Materials Handling Division of ASME. This comprehensive volume, illustrated with photographs, charts, tables, and diagrams, is divided into 47 sections covering methods of analyzing handling problems, principles, procedures, and techniques for effective operations and control; systems design and installation; integration of materials handling activities with the manufacturing processes; and the design, selection, and classification of materials handling equipment. Each section has its own table of contents. Important words and phrases in the text are set in bold face. All sections have been handled by one or more of the 84 expert contributing and consulting editors. Published by the Ronald Press, New York, the handbook is available from ASME, 29 W. 39th St., New York 18, N. Y., price $20. Members of ASME and AMHS may obtain copies of the book at a 20% discount.

HYDRAULIC TABLES and other data are given in a booklet published by the Baldwin-Lima-Hamilton Corp. This booklet is intended for those engaged in the design or in the use of hydraulic equipment—particularly those structures involving the use of hydraulic pressures for load producing purposes. Data have been collected from many sources, have been tested by experiment and by field experience over long periods, and are offered with every assurance of serviceability to the user in the solution of his own hydraulic problems. Bulletin 3300 is available upon request on company letterhead from The Baldwin-Lima-Hamilton Corp., Hamilton, Ohio.

RUSSIAN–ENGLISH ELECTRONICS AND PHYSICS GLOSSARY. Including more than 22,000 Russian terms, the Glossary was published by Consultants Bureau, Inc., 227 W. 17th St., New York 11, N. Y., priced at $10. While incorporating all previously published electronics glossaries, it eliminates duplications, and adds thousands of new terms, including idioms and selected general vocabulary. A 10-page appendix covers US–Soviet vacuum tube equivalents, unit equivalents, circuit components and notations, and abbreviations. The text specifies fields in which terms are used as explained. The new terms result from the combined experience of Consultants Bureau's physicist–translators working for U. S. Government agencies, private industry, and the American Institute of Physics. Many of these terms were encountered in the course of translating Soviet journals. The Electronics Glossary is part of a series of eight interim glossaries on specialized fields of physics being published by Consultants Bureau as a preliminary (in order to meet the current urgent need for Russian–English translation tools) to publication in 1959 of its comprehensive, authoritative, Russian–English Physics Dictionary. Prepublication subscribers to the Dictionary will also receive upon publication each of the eight glossaries, all for only $50; each Glossary sells separately at $10. The Glossaries, the first three of which are now available, are: (1) Nuclear Physics and Engineering; (2) Solid State; (3) Electronics and Physics; (4) Electricity and Magnetism; (5) Liquids and Hydraulics; (6) Acoustics and Shock Waves; (7) Mechanics and General Physics; and (8) Atomic Physics, Spectroscopy, Optics.

DEVELOPMENT OF THE GUIDED MISSILE. This revised and enlarged second edition, by K. W. Gatland, contains new chapters dealing with problems of propulsion, research into rocket techniques and requirements, and postwar work on guided bombs. An appendix reveals some details of the telemetering equipment used in British missiles, and another appendix shows photographs, to scale, of over 40 notable rockets from various countries. The table of characteristics, which was an important feature of the first edition, has also been enlarged and now provides data on 140 powered rockets from eight countries. The book is illustrated by over 100 photographs and drawings, and may be ordered from Philosophical Library, Inc., 15 E. 40th St., New York 16, N. Y., price $6.

LIST AND INDEX OF AMERICAN STANDARDS. This 67-page booklet, recently published by the American Standards Association (ASA), lists the 1,723 voluntary national standards approved by the ASA. These standards were developed by national organizations concerned with standards formulation, working either under their own auspices or within the framework of the ASA. The standards cover the electrical fields; civil engineering and construction; photography and motion pictures; textiles; mechanical engineering; safety; ferrous and nonferrous materials and metallurgy; petrolum; chemicals; acoustics and mechanical shock and vibration; mining; automotive; rubber; and a miscellany of others, including the first American Standard for nuclear energy. Included in the electrical breakdown are the following: general (fundamental and derived terms); rotating machinery; transformers, regulators, reactors, and rectifiers; switchgear; industrial control equipment; instruments, meters, and meter testing; generation, transmission, and distribution; transportation (general); transportation (air); transportation (land); transportation (marine); electromechanical applications; electric welding and cutting; illuminating engineering; electrochemistry and electrometallurgy; communication; electron devices; radiology; electrobiology including electrotherapeutics; mining; and miscellaneous. In this edition of the List and Index there are 465 new and revised standards which were not listed in the 1956 edition. The publication also lists 44 recommendations of the International Organization for Standardization (ISO) and 43 of the International Electrotechnical Commission (IEC). These are available in this country only from the ASA, U. S. member of these organizations. The publication lists the following five types of American Standards: (1) definitions, terminology, symbols, and abbreviations; (2) standards for materials, performance characteristics, procedure, and methods of rating; (3) methods of testing and analysis, (4) standards of size, weight, volume, and rating; and (5) standards of practice, health, and building construction. Information on the purchase of American Standards, discounts, and prices on special series is also included in the booklet. Free copies of the List and Index are available from Dept. DD-7 ASA, 70 E. 45th St., New York 17, N. Y.

NUCLEAR SCIENCE ABSTRACTS. This publication of the U. S. Atomic Energy Commission (AEC) Technical Information Service is intended to serve scientists and engineers working in the field of atomic energy by abstracting as completely and as promptly as possible the literature of nuclear science and engineering. It covers not only unclassified and declassified research reports of the U. S. AEC and its contractors, but also material that appears in research reports of other U. S. and foreign government agencies, universities, industrial research organizations, and in the technical and scientific journals. Each issue is indexed by personal author and by report number. Semiannual and annual index issues are prepared for each volume and include subject, corporate, and personal author, and report number indexes, listing the availability of all U. S. AEC reports abstracted. The publication is issued semimonthly and is available in single copies (priced according to the number of pages they contain, plus postage on foreign orders) or by subscription at $12 a year domestic and $15 a year foreign from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Inquiries about exchanges and other official distribution, as well as change of address notices for official and exchange recipients, should be sent to the Technical Information Service Extension, U. S. AEC, P. O. Box 62, Oak Ridge, Tenn.

## STATISTICAL COMMUNICATION TECHNIQUES and SPACE TECHNOLOGY

The transmission of information to the earth from a ballistic missile or a space vehicle presents unusual problems in communications. With severe limitations on equipment size and power, the communication system must operate in the presence of receiver noise and interference from the radio environment, including terrestrial sources and, for longer ranges, sources in space. Statistical communication techniques are valuable tools in achieving reliable communications under these difficult conditions. These techniques, by providing means for coding and decoding information and for determining the amount of information which can be sent, make possible the use of low-strength signals which otherwise could not be sorted out from the background of interference and noise.

The statistical approach is also important in the development of systems with a high degree of immunity to electronic countermeasures. The less regular or predictable the nature of transmitted waveforms, the less likelihood there is that interference will prove effective against the communication system. However, it is necessary to design the system to take maximum advantage of the near-random waveform characteristics.

Future space vehicles inherently will impose greater demands on communication systems. Systems for guidance, tracking, and data transmission through space to the moon or the nearer planets are now real goals in space technology. In the development of such systems, statistical communication techniques can be expected to play a significant role.

At Space Technology Laboratories, both experimental and analytical work are proceeding in the application of statistical techniques to the problems of space vehicle electronics. This work illustrates the advanced research and development activities in STL's Electronics Laboratory and the emphasis upon the application of new techniques to the requirements of space technology.

Both in support of its over-all systems engineering responsibility for the Air Force Ballistic Missile programs, and in anticipation of future system requirements, STL is engaged in a wide variety of research and experimental effort. Projects are in progress in aerodynamics, propulsion, structures, and electronics.

*The scope of activity at Space Technology Laboratories requires a staff of unusual technical breadth and competence. Inquiries regarding the many opportunities on the Technical Staff are invited.*

**SPACE TECHNOLOGY LABORATORIES**
*A Division of The Ramo-Wooldridge Corporation*
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**With a complete range of voltages and sizes, Continental Wire offers POWER CABLE in types V . . . AIA . . . AVA . . . AVB . . . *SILICONE RUBBER* . . . TEFLON TAPE . . . and VARNISHED GLASS TAPE for extremely high temperatures. For power cable with excellent current carrying capacities, resistance to oil, grease, corrosive vapors, moisture, as well as high temperatures—call CONTINENTAL, Wallingford.**

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# INDUSTRIAL NOTES

**Service Datalizer.** A pocket-size slide rule, condensing information normally found in more than 50 instruction books, has been devised by General Electric's (GE) Communication Products Department, Electronics Park, Syracuse, N.Y., for servicemen maintaining two-way radio systems. The Datalizer provides information on correct tuning, meter types, meter readings which normally occur in the transmitter and receiver during tuning, power supply information, and other data on two-way equipment manufactured by GE. The device is available for $1.50 from the company's independent authorized service stations located throughout the country, or from the GE Communication Products Service Parts organization.

**Anatran Becomes the Digitran Company.** The formation and move of the new Digitran Company into new headquarters at 45 W. Union St., Pasadena, Calif., has been announced. Fornerly known as the Anatran Division of Endevco Corporation, the new company independently will continue its rapid development and expansion as a maker of electrical read-out mechanical counters and digital motors for computors, automation, and systems designs.

**Four New Clark Controller Divisions.** Establishment of four new electric control product divisions and appointment of two general divisional managers has been announced by Clark Controller Company, 1146 E. 162nd St., Cleveland, Ohio. The new divisions are: Automation Division, which will handle engineered control systems and standardized controls for applications requiring integrated control systems, such as mill drives, processing lines, conveyor systems, and machine tools; Packaged Drive and Control Centers Division, which will handle standard, modified standard, and specially engineered packaged speed control drives, and control centers; Crane and Mill Accessory Controls Division, which will handle heavy-duty standard and modified standard control equipment for materials handling, mill auxiliaries, and accessory drives such as pumps, mixers, compressors, and welders; and Standard Products Division, which will handle standard and modified standard general-purpose starters, relays, limit switches, and similar equipment.

**Flight Systems for SeaMasters.** First deliveries of highly advanced flight control systems for the Martin SeaMaster, the multijet attack seaplane, were announced jointly by The Martin Company and the Sperry Gyroscope Company, Division of Sperry Rand Corporation, Great Neck, N. Y. The Sperry *SP-30* flight control system, providing automatic precision control of an aircraft from a relatively slow 100 mph to sonic speeds, has been designated standard for the United States Navy's upcoming fleet of *P6M* SeaMasters. Delivery is being made on contracts for the first 27 systems, developed especially to meet exacting jet flight requirements.

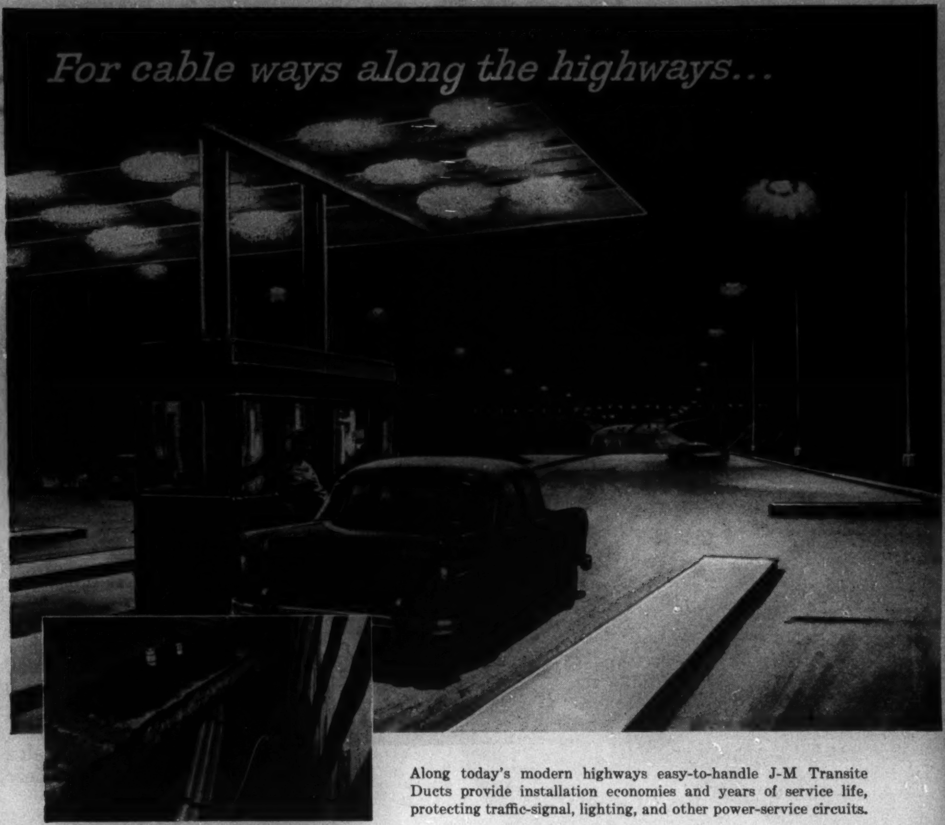
**Burndy.** An entire new line of solderless HYFEN connectors, and related crimp-type installation tooling, is announced by the Omaton Division of the Burndy Corporation, Norwalk, Conn. The connector line is designed to speed the wiring of electronic and missle harnesses and add greater dependability by utilizing crimped pins and sockets that snaplock into a plug or receptacle. Elimination of solder provides greater reliability and speeds production time, with the application of the HYFEN principle allowing the design of lighter and more compact equipment. Burndy also announces a new line of compression tooling, especially designed for the installation of HYFEN connectors. In addition to this new line, the rapid growth and expansion necessitated dispersion of manufacturing, warehousing, and shipping facilities. Burndy has just completed and now occupies a new and modern central warehouse, located at the company's headquarters plant in Norwalk, Conn.

**Silicare.** Silicone-based hand cream not only eliminated a serious skin irritation problem at the Stator Electric Company, Woodside, N. Y., but it also cut their motor rejection rate from 20% to almost zero. Silicare is a product formulated with Dow Corning silicones by Revlon, Inc. A heavy but greaseless liquid, the cream was simply rubbed into the hands and arms until it disappeared. For further information contact Dow Corning Corporation, Midland, Mich.

**Fairchild Camera Combines Two Activities.** Fairchild Camera and Instrument Corporation, Robbins Lane, Syosset, L.I., N. Y. has announced the integration of its Reconnaissance Systems and its Electronics Divisions into a new Defense Products Division, aimed at broadening its military products base. In addition to reconnaissance systems, the new division will continue its research and development in other product lines.

**Radome Test Center.** A private facility for pretesting reinforced plastic radomes has been opened by Zenith Plastics Co., Gardena, Calif., and plans have been announced to make the test facilities available on an industry-wide rental basis. The new facilities provide more room, offer more test controls and produce more accurate test results in less time than was previously possible, according to spokesmen for the firm. Up to 18 radomes can be tested simultaneously from the 3-story master control center with its six radially dispersed testing towers. The test center was designed and built by Zenith, the world's largest producer of reinforced plastics for the aircraft industry. It is a subsidiary of Minnesota Mining and Manufacturing Co., 900 Bush St., St. Paul 6, Minn.

*(Continued on page 26A)*



Along today's modern highways easy-to-handle J-M Transite Ducts provide installation economies and years of service life, protecting traffic-signal, lighting, and other power-service circuits.

**J-M Transite® Ducts** install fast to last... give complete cable protection.

**Because speed and economy** set the pace in today's highway programs, more and more highway cables are going into Johns-Manville Transite Ducts.

**For speed,** Johns-Manville Transite Ducts are strong, light and long—easy to handle and install. Workmen set 10-foot lengths in place easily, join them up tight in seconds with snug-fitting J-M Plastic Couplings, and Transite's smooth bore is free of burrs and other obstructions that may interfere or cause damage during pulling of cables.

**For economy,** J-M asbestos-cement Transite Ducts go in to stay. Non-conductive Transite is not affected by electrolysis—resists the corrosive action of fills or high-salt soils in permanently damp locations. Millions of feet of installed Transite Ducts have proved that Transite withstands earth loads and soil stress . . . resists vibration and shock from highway traffic.

**Let us** send you free Transite Duct brochure EL-29A. Write Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

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**J-M Korduct® for concrete banks**

Johns-Manville Asbestos Transite Ducts can be laid directly in trench without concrete envelope or other mechanical protection.

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FOUR distinct divisions in **one** steel company, inter-related, specialists in their own field of endeavor and singly managed.

Some clients take advantage of all **four**, others one or more.

**Fabricated Structural Steel and Fabricated Reinforcing Steel for Bridges, Commercial and Industrial Buildings: Schools, Hospitals, Power Plants, Coal Washing Plants.**

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**Carbon Steel Warehouse Products: Structural and Bar Shapes, Plates, Hot and Cold Finished Bars, Construction Products.**

**Pressure Vessels fabricated to the ASME Code from Carbon, Alloy, and Alloy Clad Steels for the Chemical and Petroleum Processing Industries.**

*for over 40 years*

**FLINT STEEL CORPORATION**

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## Industrial Notes

*(Continued from page 18A)*

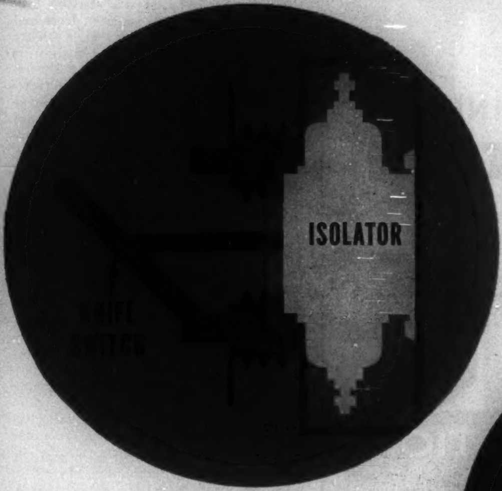
**Traid to Distribute Zoomar Supersonic Lens.** A supersonic lens which is built to withstand heat friction, shock, and vibration at airborne speeds of Mach 4 and higher, will be distributed by Traid Corporation, for Zoomar, Inc. The lens will be used in high-speed fighters and bombers, drones, guided or ballistic missiles, and in upper-air research craft. Developed by Zoomar, Inc., the supersonic lens will be distributed exclusively by Traid Corporation, manufacturers and distributors of photographic instrumentation cameras, systems, and accessories. Having extremely low aerodynamic drag, the lens does not heat excessively at high speeds. For further information, please contact Mr. F. G. Roberts, President, Traid Corporation, 17136 Ventura Blvd., Encino, Calif.

**Space Vehicle Tracking System.** An antenna system for microprecision control of mammoth antennas will be used to track space vehicles in the form of satellites, space platforms, or rocket ships en route to the moon. A novel proprietary method of antenna mount would allow a lower cost azimuth and elevation drive to perform the motions of the more complex equatorial mount without sacrificing any of the necessary precision as the antenna automatically tracks a star, the moon, the sun, or a space vehicle in orbit. This design will save many thousands of dollars in manufacturing costs. For further information contact General Bronze Corporation, 711 Stewart Ave., Garden City, L.I., N.Y.

**Electrical Work Precedents in Housing.** One of the largest New York City Housing Authority developments yet completed, the Marlboro Houses, has set precedents in electrical design and construction for large-scale, low-cost housing. It has 29 fireproof buildings—three 16-story units and 26 seven-story units, with a total of 1,875 apartments. Instead of conventional corridors, the 16-story buildings have open balconies, where snow that may accumulate is melted by electric heating cables buried in the floor slabs. Cables have a solid nickel-chromium conductor with silicone rubber insulation, copper shield, and silicone rubber jacket. Apartments specially designed for the aged have electric ranges. Interior halls in the 16-story buildings and all bathrooms are windowless, ventilated by time-clock controlled fans on the roof. Lighting of the site and the balcony corridors is also clock-controlled. The apartment buildings are master metered. Each 7-story building has a 600-ampere service switch, each 16-story building a 1,200-ampere switch. Branch circuits from these entrances took a total of 650,000 feet of rigid steel conduit and 1.5 million feet of wiring. Electrical work, like the buildings themselves, is fireproof. For further information contact Burndy Corporation, Norwalk, Conn.

*(Continued on page 34A)*

# 3 big reasons why ISOLATORS are the ideal disconnects

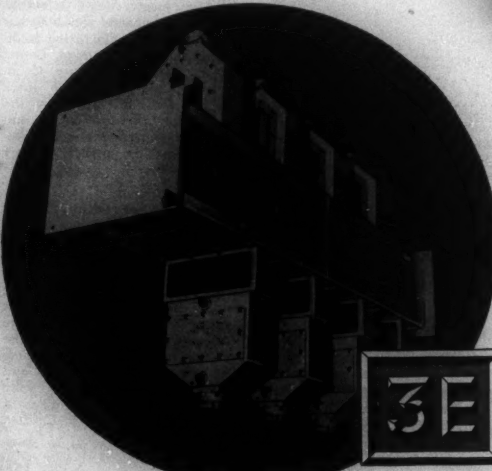


### *ISOLATORS save space*

Using ⅓ the space required by an equally rated knife switch, ISOLATORS cut down the cost and labor of cubicle construction as well as floor space. They are easy to install . . . light in weight and are shipped complete with all elements mounted and aligned in a rigid frame.

### *ISOLATORS are safe!*

The ISOLATOR's straight line switching action greatly reduces hazard from live parts. In all switch positions the live parts are effectively shielded by an insulating sleeve and there is a clearly visible gap in the open position.



### *3E combines ISOLATORS and bus ducts to make the ISO-DUCT...*

. . . an extremely practical switching center that saves space and is ideal for expansion in either direction. The ISOLATORS can be combined and interchanged with potheads in any arrangement. The ISO-DUCT is neat, handsome and efficient . . . the ideal switching center for any plant.

*Write for Bulletin 140*

3E

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TELEPHONE AND TELEGRAPH EQUIPMENT

Radio Engineering Products is currently producing a number of types of equipment, electrically and mechanically interchangeable with standard Bell System apparatus.

CARRIER-TELEPHONE EQUIPMENT

C5 Carrier-Telephone Terminal (J68756). A kit for adding a fourth toll-grade channel to existing C systems is available. • C1 Carrier-Telephone Repeater (J68757) • 121A C Carrier Line Filter • H Carrier Line Filter (X66217C).

CARRIER-TELEGRAPH EQUIPMENT

40C1 Carrier-Telegraph Channel Terminal (J70047C) • 140A1 Carrier Supply (J70036A1, etc.) • 40AC1 Carrier-Telegraph Terminal.

VOICE-FREQUENCY EQUIPMENT

V1 Telephone Repeater (J68368F) • Power Supply (J68638A1) • V1 Amplifiers (J68635E2 and J68635A2) • V3 Amplifier (J68649A) • V-F Ringers (J68602, etc.) • Four Wire Terminating Set (J68625G1) • 1C Volume Limiter (J68736C).

D-C TELEGRAPH EQUIPMENT

16B1 Telegraph Repeater (J70037B) • 10E1 Telegraph Repeater (J70021A) • 128B2 Teletypewriter Subscriber Set (J70027A).

TEST EQUIPMENT

2A Toll Test Unit (X63699A) • 12B, 13A, 30A (J64030A) and 32A (J64032A) Transmission Measuring Sets • 111A2 Relay Test Panel (J66118E) • 118C2 Telegraph Transmission Measuring Set (J70069K) • 163A2 Test Unit (J70045B) • 163C1 Test Unit (J70045D).

COMPONENTS AND ACCESSORIES

255A and 209FG Polar Relays • Repeating and Retard Coils, several types • 184, 185, 230A and 230B Jack Mountings.

RADIO ENGINEERING PRODUCTS

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CABLES
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## Industrial Notes

*(Continued from page 26A)*

**Volume Output of Hi-Fi Transistor.** Minneapolis-Honeywell Regulator Company has announced that it was starting full-scale production of its recently developed power tetrode transistor for high fidelity and other audio uses. The transistor is described as having unusual high-frequency and low-distortion characteristics for high fidelity use. It has a frequency response up to 20,000 cycles per second with only 2% distortion. Honeywell's applied research work in semiconductor products will continue at the Boston Division. Basic research work in the field is carried on at the Honeywell Research Center, Minneapolis, Minn.

**Chemical Milling.** Close co-operation between the electronics industry and United States Chemical Milling Corporation, 1700 Rosecrans Ave., Manhattan Beach, Calif., has resulted in uses of chemical milling to solve many difficult design and production problems. Chemical milling, because it produces dimensions to extremely close tolerances, is particularly adaptable to the electronics industry, which requires precise manufacturing techniques. Reducing the weight of parabolic antennas is an example of chemical milling as utilized in electronics. There are many other applications of chemical milling in the electronics industry, such as the weight reduction of metal cases for electronic gear. In addition, new applications are expected from the continuing research that is being carried on by the engineers at United States Chemical Milling Corporation in co-operation with many of the nation's leading electronics firms.

**Controls Division Moves.** The Industrial Controls Division of Manning, Maxwell & Moore, Inc., manufacturer of electronic instruments for measurement, transmission, and control of process variables, has moved its offices and manufacturing facilities from the company's Stratford, Conn., plant to a new plant in Danbury, Conn. The company plans to use the space vacated in the Stratford plant by the Industrial Controls Division for its nuclear components department which produces products for the nuclear energy field.

**Electra Opens Chicago Office.** Electra Motors, Inc., Anaheim, Calif., has opened a new office in Chicago, Ill. for direct sales and service to Illinois, Indiana, and Wisconsin. Named as Midwestern Division manager is W. A. Greaves. In charge of the new office is W. D. Funk, district sales manager. Sanford Novitt will serve as inside sales engineer. In addition to the new office, a warehouse with complete stock of Electra-Motors, gearmotors, and gearducers will be maintained to serve the entire Midwest. The new office is located at 10229 Ridgeland Ave., Chicago Ridge, Ill.

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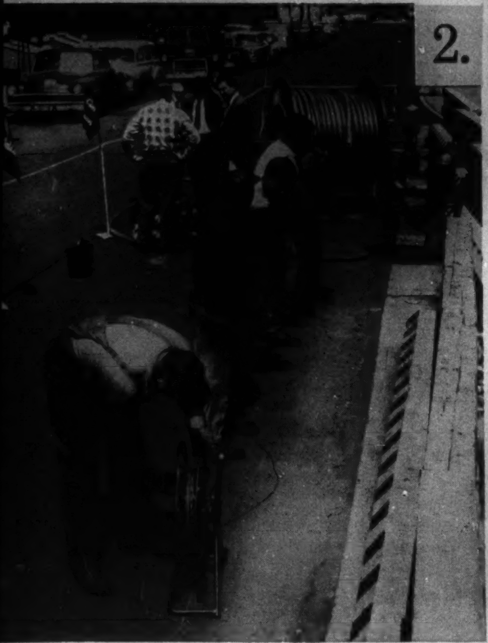
2.

3.

**1.** Reels are lowered onto street from winch truck, while workmen clean the 4-inch prefab concrete ducts.

**2.** Crew pulls the steel wire brushes through ducts to remove pebbles and dirt. Pull here is 393 feet.

**3.** Cable is heavily lubricated with special pulling compound before it goes into the baloney.

**4.** Winch truck begins pull, maintaining a 20-foot-per-minute rate.

4.

TIGER BRAND

## USS TIGER BRAND ELECTRICAL WIRE & CABLE

*a standard Tiger Brand Cable for every special job*

- Asbestos Wire and Cable
- Mold Cured Portable Cord
- Shovel & Dredge Cable
- Paper & Lead Cable
- Varnished Cambric Cable
- Interlocked Armor Cable
- Special Purpose Wire & Cable
- Aerial, Underground and Submarine Cable

**UNITED STATES STEEL**

USS
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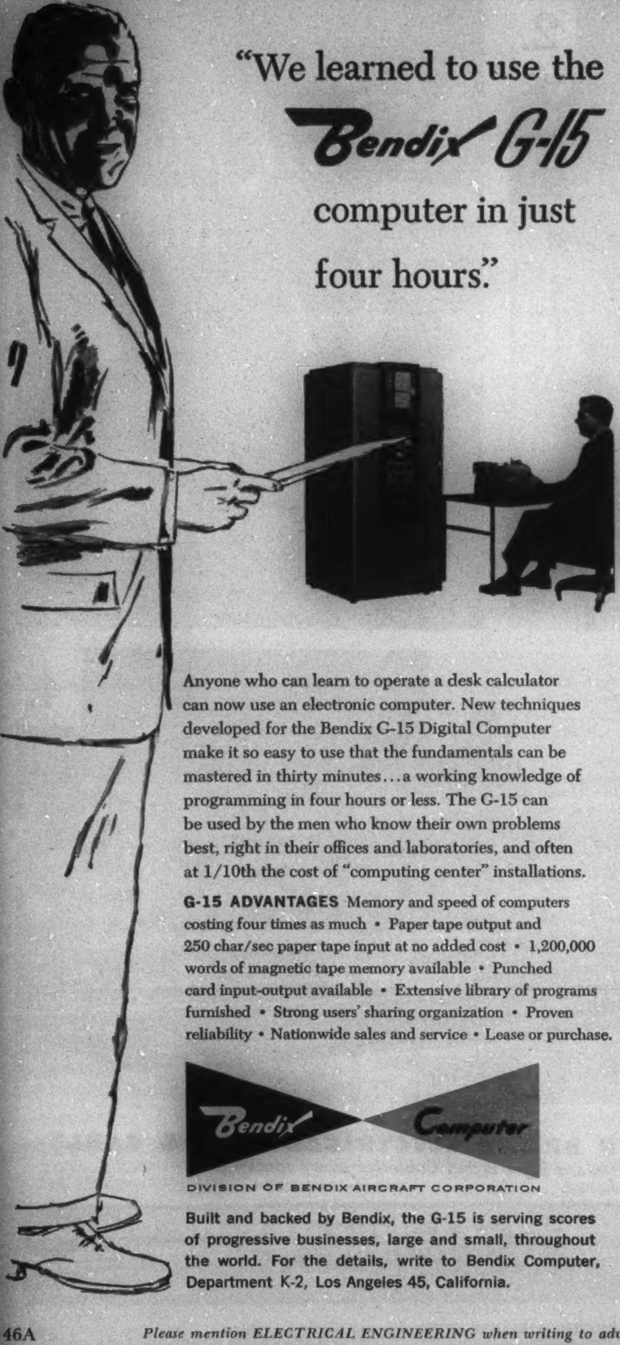

"We learned to use the Bendix G-15 computer in just four hours."

Anyone who can learn to operate a desk calculator can now use an electronic computer. New techniques developed for the Bendix G-15 Digital Computer make it so easy to use that the fundamentals can be mastered in thirty minutes...a working knowledge of programming in four hours or less. The G-15 can be used by the men who know their own problems best, right in their offices and laboratories, and often at 1/10th the cost of "computing center" installations.

**G-15 ADVANTAGES** Memory and speed of computers costing four times as much • Paper tape output and 250 char/sec paper tape input at no added cost • 1,200,000 words of magnetic tape memory available • Punched card input-output available • Extensive library of programs furnished • Strong users' sharing organization • Proven reliability • Nationwide sales and service • Lease or purchase.

Bendix Computer

DIVISION OF BENDIX AIRCRAFT CORPORATION

**Built and backed by Bendix, the G-15 is serving scores of progressive businesses, large and small, throughout the world. For the details, write to Bendix Computer, Department K-2, Los Angeles 45, California.**

## Industrial Notes

*(Continued from page 34A)*

**Rhodium-Plating.** A method of rhodium-plating commutator segments has been developed which prolongs the life of electric motors while, at the same time, eliminating radio interference and reducing power consumption. The procedure is particularly advantageous because it is fast and inexpensive, and because commutators may be treated without having to immerse the entire armature in a corrosive plating solution. Thus, this plating avoids the danger of damaging the windings. For additional information concerning this application of the Dalic process, write to Marlane Development Company, 153 E. 26th St., New York 10, N. Y. In Canada, write to Dalic Metachemical Ltd., 121 Judge Rd., Toronto 18, Ont., Canada.

**Processing System Released for Sale.** The National Cash Register Company has announced that it has released for sale the company's new *304* electronic data processing system. The marketing of this series officially marks the entry of the Dayton, Ohio, business machine manufacturer into the commercial computor field. Earlier electronic computors sold by NCR were designed for scientific applications rather than business use.

**Chemplast Expands.** An expanded facility for the production of Teflon (tetrafluoroethylene resin) rods has been announced by Chemplast, Inc., 3 Central Ave., East Newark, N. J. These increased facilities, coupled with newly developed extrusion techniques, enable the company to produce rods of Teflon in diameters from 1/32 inch to 2 inches, in extremely small increments. Chemplast also announces expanded warehousing, which permits the company to give immediate delivery on all sizes of rod stock. For further information, write to Stephen Dorn, Sales Manager, Chemplast, Inc., 3 Central Ave., East Newark, N. J.

**Philco-Built Air Force Communications System.** A contract to build a 295-mile communications system for the Air Force Eglin Gulf Test Range has been awarded to Philco Corporation's Government and Industrial Division, 4700 Wissahickon Ave. Philadelphia 44, Pa. Outstanding features of this communications project are the 115-mile microwave relay system and the 180-mile, single hop, tropospheric scatter system. This over-the-horizon scatter hop will span the Gulf of Mexico from Cape San Blas to Anclote Point, about 25 miles northwest of Tampa, Fla.

**Company Move.** Martin Mann Associates, manufacturers' representative in southern California and Arizona, proudly announce the completion of their move into new enlarged quarters at 14751 Keswick St., Van Nuys, Calif. This new facility provides additional office space and greatly expanded warehouse facilities, with ample off-street private parking.

*When choosing a premium power cable . . .*

# How much choice do you really have?

Cable may *look* alike—but you can find many differences in jackets and insulating compounds. And you want only the *best* cable for your operating conditions.

That's why it's important to choose your cable from a manufacturer who offers you a real choice of modern cable materials.

**Full choice of insulating compounds**

Only three major companies give you a choice of *either* oil-base or butyl-base insulation. Rome Cable is one of these three and offers a choice of Rozone A (butyl-base) and Rozone (oil-base) insulations.

And, in addition, Rome can offer you a *polyethylene* insulation for high voltages.

You can match your operating needs more closely with cable insulation that puts the emphasis on what you want most—resistance to heat, moisture, ozone cutting, or any combination of properties. You can be sure of this choice when the cable is made by Rome Cable.

**Getting the right jacket**

In modern jacket materials, too, the same kind of freedom works to your advantage. You get a choice, with Rome Cable, of Roseal (special flame-retardant polyethylene); Roprene (a Rome-developed neoprene compound for use with rubber insulations); Rolene (polyethylene); and several other high-quality jacketing compounds. Each has its own advantages, depending on your requirements.

**Bring your cable problems to Rome**

When you discuss your premium cable requirements with your Rome Cable representative, you can count on his recommending the *right* cable for you. No matter what type of cable you choose, take advantage of Rome's ability to offer you a *real* choice.

For more information on the choice you get with Rome's power cable, contact him now—or write to Department 713, Rome Cable Corporation, Rome, New York.

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Telemeter
ANY VARIABLE
from Remote Points

*Accurate, Fast Acting, Frequency Type Telemeter for Transmission over Wire Lines, Microwave, and Power Line Carrier*

Accurate
HIGH-SPEED
Continuous
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VOLTS
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Built-in
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Calibrating
Circuit
•

The Model 1025 Telemeter Transmitter converts DC mv from thermal converters, etc., to 10-30 cps which frequency modulates a built-in audio tone channel. AC 10 to 30 cps or relay outputs are also available. Receiver detects and demodulates transmitted signal, generating a DC mv for operation of recorders or indicating instruments. Up to 45 telemeters can be multiplexed.

Any communication link, including power line carrier, microwave or wire line may be used.

Over-all accuracy is 1% with a response speed of 1 second. Equipment features a built-in calibration circuit for 10% and 90% receiver check, and 10 cps and 30 cps transmitter check.

Any quantity which may be converted into a DC millivoltage or will operate a slidewire may be telemetered.

**WE CAN HELP YOU**
Our Applications Department is ready to assist you in your control, telemetering or communications problem. Phone DEerfield 4-3100.

**Write for Technical and Application Data.**

Radio Frequency
LABORATORIES, INC.
Boonton, New Jersey, U. S. A.

# NEW PRODUCTS

**Kart-O-Matic Equipment.** This new equipment simplifies transporting and winding in the cable and wire rope fields. Ideal for re-reeling cable from one reel to another, the power drive used on Kart-O-Matics can be used on the Marion Coiler Stand and also for pulling cable through conduits and threading pipe. Two models are available: Kit No. 1032 and Kit No. 1042. Free literature is available from the manufacturer. Write Weber Electric Manufacturing Co., Inc., 15224 Kercheval, Detroit 30, Mich.

**Alarm-Control Unit.** Important new features and alarm sequences are now being offered with this annunciator which monitors any process or plant variable. Electro-Pane using a conservative design of powerful coil-operated mercury switches has proved extremely reliable. Additional mercury switches combined with mechanical tripping latch action allow alarm units to be used directly in control, thereby eliminating troublesome relay circuits. Now included are individual pull-out units which when disengaged completely isolate external sensing contacts, thus simplifying the process of checking for grounds. Individual units can be completely disassembled and inspected in the field. For further information contact Electro Devices Incorporated, Main Sales Office, 116 S. Michigan Ave., Chicago 3, Ill.

**Photocopier Ends Chemical Mixing.** Engineers and builders will welcome the news of a new continuous photocopying machine, the Contoura-Matic. The revolutionary feature of the photocopier is a plastic cartridge in which the processing liquid is premixed, removing messy mixing and pouring, and adding new efficiency to photocopying. The new cartridge does for the photocopier what the ink bladder did for the pen industry. With this innovation, the plastic container filled with premixed chemical developer is snapped into place so that it pours in and out of the machine automatically. In this way, the new air-tight container gives longer life to the liquid because it never comes in contact with air when not in use. The Contoura-Matic is manufactured by F. G. Ludwig, Inc., Dept. C-M, 105 Coulter St., Old Saybrook, Conn.

**Push-Button Carrier Voltage Attenuators.** Designed for use in laboratory development work and in the production and testing of electronic equipment, a series of push-button carrier voltage attenuators is available. Called the *Alectra 40* series, the first two of these instruments (Models *40A* and *41A*), operate in the frequency range from d-c to 600 kc. Further information appears in CEC Bulletin *7008*, available from Alectra Division, Consolidated Electrodynamics Corporation, 325 N. Altadena Dr., Pasadena, Calif.

**Data Recording System.** This multi channel data recording and reproducing equipment has been introduced by Magnasync Manufacturing Company, Ltd., 5546 Satsuma Ave., N. Hollywood, Calif. The system employs perforated 35-mm magnetic film as recording media. The film is driven by a 32-tooth precision sprocket and synchronous drive motor to insure positive timing accuracy required for rocket engine testing and missile tracking. Audio components are plug-in assemblies. Information on the special recording systems is available from the company.

**Air-Index Adaptor.** A major development in air valving, with a totally different design concept, is offered by Ross Operating Valve Co. in its single momentary Double Stroke Adaptor. This air-index adaptor converts any long-life "Skyline" series valve to momentary action. It can be inserted between any Skyline series head and body combination, providing a new approach to momentary valve action. For further information, contact a company representative or write Bill Graham, Sales Dept., Ross Operating Valve Co., 120 E. Golden Gate Ave., Detroit 3, Mich., for Bulletin No. *316*.

**Direct Measuring Microscope.** This optical measuring tool utilizes a pocket comparator at the eyepiece end to project an image of the reticle pattern directly on the work. The operator reads exact measurements directly from the reticle; no calibration is required. The instrument provides a full 6-inch working distance between the objective and the object in view. The viewer sees an erect image. Design of this instrument is such that one can see and measure in deep down places, through glass; one can even measure compressible substances. Dozens of industrial applications are possible for checking small parts and linear dimensions, diameters, radii, and angles. Linear dimensions are given both in inches and millimeters. The reticle of the comparator supplied is precision etched, dependable for long, accurate performance. For further information contact Edmund Scientific Corp., 101 E. Gloucester Pike, Barrington, N. J.

**Reliable Punch Press Double-Stop Control.** A sensitive, reliable, and inexpensive punch press double-stop control, designed to prevent shut-down time on high-speed automatic and semiautomatic punch presses and to protect against damage to presses and dies, has been developed. The punch press control is equipped with an indicating pointer activated by a current transformer. Responsive to the current, this pointer moves across the dial of a contact ammeter, displaying continuously and visibly the load on the drive motor. A second adjustable pointer is set slightly above the level of the current required to operate the press when the die contains its customary single piece of metal, one of normal hardness or thickness. Write Tipptronic, Inc., Dept. PP, Chagrin Falls, Ohio, for further information.

*(Continued on page 52A)*

No. 4 in a series

# Right off the Wire

Power for earth satellites could be supplied by a new chemical battery that uses a dye to convert sunlight into electricity.

&

A new bearing metal of tin and aluminum is said to combine the bearing qualities of one with the light weight of the other.

&

Negatively ionized air is being used as a painkiller for patients with severe burns. After two exposures of twenty minutes each no narcotics are needed.

&

Users of High Voltage cables should note that high molecular weight polyethylene can be expected to have a voltage life about seven times that of standard polyethylene. (From paper on Dielectric Strength and Voltage Life of Polyethylene, presented at AIEE Winter General Meeting, February 1958, by Messrs. Hunt, Ware and Koulopoulos of Simplex.)

&

A new, automatic door opener is installed overhead, like a door check, and requires no complex, under-floor wiring. It can be installed in a few hours.

&

In a new cook stove the heat is generated in the utensil by putting it in a magnetic field. No heat is wasted and spilled food does not burn. It is said to be faster than ordinary electric stoves.

&

The "cage zone" melting system has proved successful in purifying niobium. Under high vacuum the metal is melted by high frequency current and the impurities separate to be cut off later.

&

A vinyl lining material for swimming pools of masonry or wood is in the form of sheeting with an adhesive back that sticks to the sides and assures complete waterproofing.

To meet the growing demand for power by industry, Simplex has installed new equipment that allows cable cores of greatly increased diameters to be armored with CONDEX, the interlocking armor tape made by Simplex since 1924.

&

Printed pages can actually be made to talk by means of a Japanese invention. The back of the paper is treated like magnetic tape and produces recorded sounds when a reproducing head is passed over the printed words.

&

**Further information on these news items and on Simplex cable is available from any Simplex office. Please be specific in your requests.**

&

A new, thirty-nine-passenger bus for intercity service is claimed to have many advantages. It has a flat floor (no step-up to seats), a "recreation area," lavatory, reclining seats and air suspension.

&

The size of electrical components may be further reduced by a process for putting tiny germanium transistors into printed circuits.

&

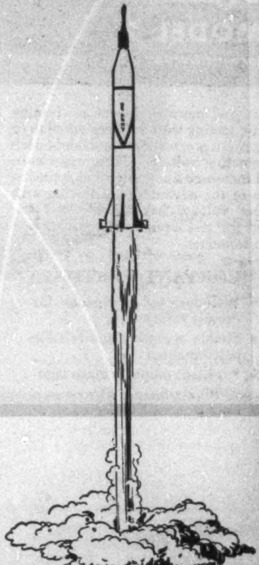
Buildings are being erected with the use of balloons instead of derricks.

&

A method of projecting color pictures on a screen from black and white slides has been discovered.

&

An acknowledged leader of the cable industry in research and manufacturing skills, Simplex scientists and engineers present technical papers on a variety of subjects of interest to users of insulated cables. A list of papers read before the AIEE and other associations will be sent on request.



## Underwater nerves take the "miss" out of missiles

Test rockets fired from the U. S. Air Force Test Range in the Bahama Islands are tracked electronically from a series of check points along their routes. This close observation detects the slightest variance from the missiles' intended flight path. The vital communications link for this work is a 1400-mile Simplex submarine cable to Puerto Rico — a product of the world's most modern techniques in under-water cable manufacture.

For high voltage power transmission or the most exacting communications cables, Simplex' research, engineering and manufacturing facilities are at your service.

**SIMPLEX WIRE & CABLE CO.**
Cambridge, Massachusetts and
Newington, New Hampshire

Simplex

*Highest quality cables for:* [illegible]
Power & Lighting • Construction
Transportation • Communications •
Signalling

*"the American manufacturers of transoceanic telephone cables"*

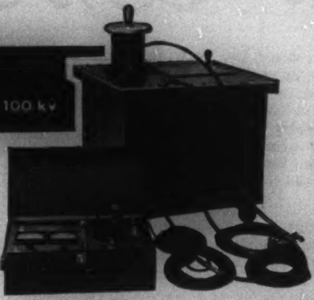
BIDDLE DIELECTRIC TEST EQUIPMENT

**. . . for measuring direct current at voltages up to 100 kv when applied to the insulation of generators, transformers, bushings, cable, etc.**

*New*

MODEL 2

current output 6 ma continuous at 100 kv



More and more engineers are leaning to d-c testing with voltages equal to or somewhat greater than equivalent peak alternating voltages. Their experience and increased knowledge and appreciation of the advantages of testing with direct voltage have accelerated the need for test equipment to meet field requirements.

IMPORTANT FEATURES

- Well-designed provisions for utmost safety
- Simple operation and reliable performance
- Excellent output voltage regulation
- Compact, mobile design
- Facilities for voltage and leakage current measurements

IMPORTANT APPLICATIONS

*. . . in development . . .* for testing the d-c dielectric strength of insulating materials and the adequacy of the electric design of insulation in any type of electrical equipment.

*. . . in production . . .* for non-destructively detecting defects in the insulation of electrical equipment due to design, material, and workmanship.

*New*

MODEL 1-A

3 ma continuous at 40 kv

CAUTION
HIGH VOLTAGE

*. . . in maintenance . . .* for non-destructively detecting unreliable condition of insulation of new or repaired electrical equipment. Preventive maintenance tests on important rotating equipment, cable, switchgear, etc., result in appreciable savings.

For important details regarding these units and information on the subject of high voltage d-c testing *write for our New Bulletin 22-EE.*

B-800

JAMES G. BIDDLE CO.
1316 ARCH STREET • PHILADELPHIA 7, PA.
ELECTRICAL TESTING INSTRUMENTS • SPEED MEASURING INSTRUMENTS
LABORATORY & SCIENTIFIC EQUIPMENT

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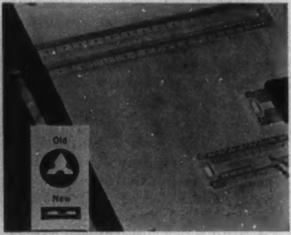
1316 Arch St., Phila. 7, Pa.
Please send me
BULLETIN 22-EE

Name__________
Company__________
Address__________
City__________ Zone____ State____

## New Products

*(Continued from page 50A)*

**Flipless Scale.** This ingenious pocket or desk model scale ends the well-known hunt for buried measures by displaying eight different scales on a single side. Unlike its bulky triangular cousins, it never has to be flopped or twirled. Whatever scale you need is at your pencil-tip because all eight scales have been laid out side by side instead of one under the other. Each scale has its own straight edge, calibrated to professional standards. It has been made of tough, crystal clear acrylic. Thus, the scale calibrations become comparative parts of the print, plan, or schematic drawing. They can be ordered directly from A. Lawrence Karp, 16 Putnam Pk., Greenwich, Conn.



**Low-Noise Choppers.** A chopper with noise levels below 10 microvolts in low-impedance circuits is being manufactured. These noise levels are for wide-band noise extending from a few cycles per second up to 40 kc and are measured by a thermocouple voltmeter (true rms reading). The low noise is achieved by chopper construction. These few microvolts of chopper noise can be further reduced in particular applications by restricting the bandwidth following these new choppers. The choppers are manufactured by The Airpax Products Company, Cambridge Division, Cambridge, Md.

**Automatic Component Tester Uses Card Programming.** Incoming inspection of transformers, relays, resistors, transistors, diodes, capacitors, and similar items is performed automatically by a component tester manufactured by California Technical Industries. The unique feature of this instrument is its ability to make a complete series of tests according to values indicated by a punched card, thus enabling it to make complex tests on a component, and yet permitting instant changeover to the next type of component. The component tester is supplied in a cabinet suitable for both rack mounting and bench use. Physical dimensions are $10\frac{1}{2}$ by 19 inch front panel, 21 inches deep. Contact California Technical Industries Division of Textron Inc., 1434 Old County Rd., Belmont, Calif., for further information.

*(Continued on page 54A)*

SAFETY M.I. CABLE

the answer to industrial power wiring...

- SPACE SAVING
- Time saving
- Permanent
- INSTALLED EASILY
- Fast power wiring to cut down-time

More and more General Cable's Safety MI 600 Volt Wiring System is being used because it can take the abuse of industrial application, giving trouble-free operation and unexcelled performance under the most severe conditions. Particularly adaptable in hot and wet locations. Available in 1, 2, 3, 4 and 7 conductor for power and control circuits.

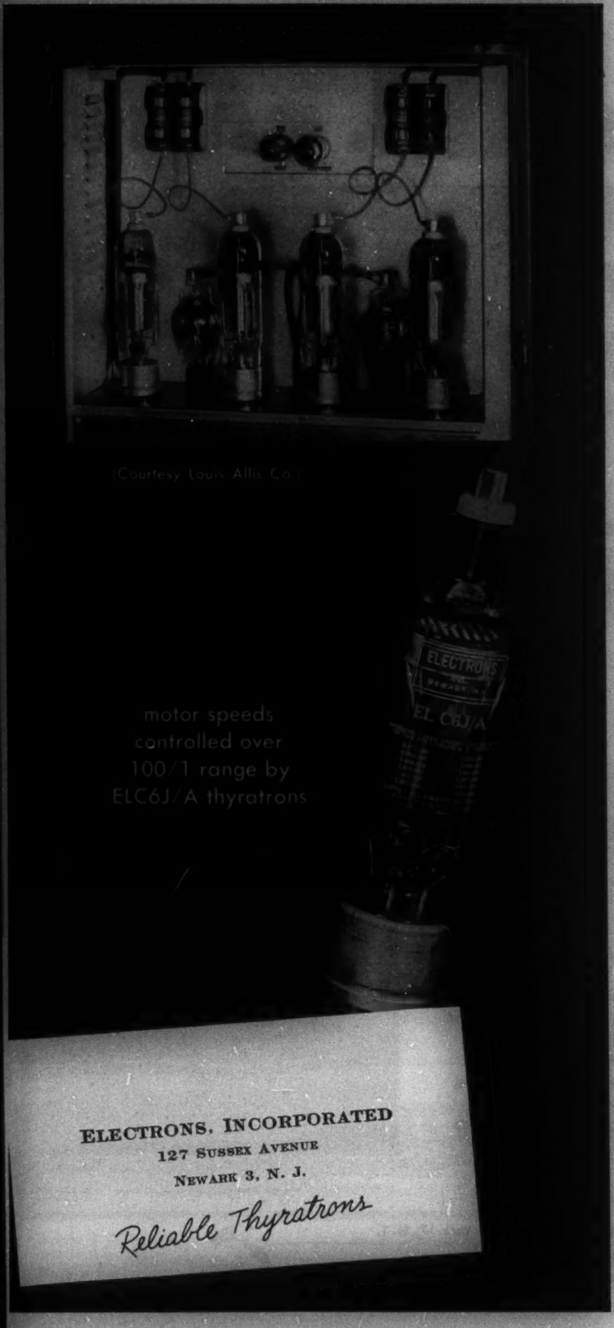
MI terminating in main Japan Oven control center switchboard at Poinsett Lumber and Manufacturing Company, Anderson, S.C.

*Ask for a Demonstration To-Day!*

**GENERAL CABLE CORPORATION,** 420 Lexington Avenue, New York 17, N. Y.

*Offices and Distributing Centers Coast-to-Coast*

***for quality and service...specify*** GENERAL CABLE



(Courtesy Louis Allis Co.)

motor speeds controlled over 100/1 range by ELC6J/A thyratrons

ELECTRONS, INCORPORATED
127 Sussex Avenue
Newark 3, N. J.

Reliable Thyratrons

(Continued from page 52A)

**Line Amplifier and Remote Power Supply.** A new concept in television distribution system engineering with the *DLX-26* distribution line extension amplifier and the *RPS-B* remote power supply has been announced. The *DLX-26* is a broadband, 54 mc to 88 mc, amplifier providing a 20-db gain (maximum output, +36 db millivolt). It can be used for extending existing distribution lines, for increasing line levels so that additional tap-offs may be added, or for overcoming the increase in cable losses with age. The power supply arrangement is the unique feature. It allows the *DLX-26* to be powered directly from a 115-volt a-c line, or remotely with the power signal received over either the input or output signal-carrying coaxial cable. Thus, the amplifier can be mounted exactly where it is needed, even if no power line is available at that point. The *RPS-B* is the remote power source. A control is provided for adjusting the voltage output to the proper level to offset the line losses in different lengths of cable. A panel meter gives constant monitoring of the current drain. Write Entron, Inc., 4902 Lawrence St., Box 287, Bladensburg, Md., for further information.

**Noiseless, Blastless Exhaust Tools.** A series of portable tools with noiseless, blastless exhaust has been introduced by Aro. Initial models now available are light- and medium-duty types of drills, screwdrivers, and tappers. Nearly all company air tools eventually will incorporate noiseless exhaust. To achieve this effect, the company has redesigned its entire line of air tools. Heretofore, most air tools have been so designed that air moves generally in a forward direction from the inlet to the exhaust port, and escaping air moves only a short distance from the cylinder before being vented. In the new tools, the exhaust air is now routed back through a system roughly parallel to the inlet system, and escapes at a point adjacent to the air inlet. Additional information may be obtained by contacting J. R. Markey, Manager Industrial Relations, The Aro Equipment Corporation, 1949 Erie Ave., Bryan, Ohio.

**Module Fixture.** An advance in lighting design has been introduced by Leadlight Fixture Company. Module type fixtures have been produced up to this time with closed top only. The Spacelighter consists of a rigid frame forming the periphery of the fixture, leaving the entire top open. The diffusers rest on a flange around the inside bottom edge of the fixture, similar to the previous model. The advantages of this construction are: extremely light weight for ease in installation, open top construction, reduction in cost, and no striations because transformers are in side channels. Detailed information about this fixture can be obtained by writing to Leadlight Fixture Company, 800 100th Ave., Oakland 3, Calif.

To simplify your power equipment design

REVERSE POLARITY TYPES

OPTIONAL MOUNTING STYLES

Versatility...

in 25 to 250 ampere
Silicon Power Rectifiers

# International Rectifier Corp.

**VERSATILITY** in types, ratings and mounting configurations, coupled with *field proven reliability* and high efficiency can add up to a simplified, more dependable design for your industrial power rectifier equipment. Mechanical interchangeability with other available types makes quick replacement possible, enabling you to benefit *in performance* from the advanced design, manufacturing and test techniques developed to meet the most rigid military requirements... now used in the production of all silicon power diodes!

**REVERSE POLARITY TYPES.** In addition to optional base configurations, diodes are available in reverse polarity types, further simplifying stack construction—resulting in a smaller, lighter completed assembly.

| Type | Current Rating | Voltage Rating | Bulletin |
|---|---|---|---|
| 25 series | 25 to 45 amps. | 50 to 600vPIV | SR-304 |
| 45 series | 45 to 150 amps. | 50 to 800vPIV | SR-300 |
| 70 series | 70 to 250 amps. | 50 to 400vPIV | SR-305 |
| Military types (includes 1N412B) | 35 amps. | 50 to 1000vPIV | SR-303 |

**Complete assemblies utilizing these diodes are also available.**

You are invited to investigate increased efficiency and possible savings in space, size and weight these rectifiers can bring to your equipment. Samples for your own evaluation tests will be supplied upon qualification of your application requirements. Write today or contact our representative.

EXECUTIVE OFFICES: EL SEGUNDO, CALIFORNIA • PHONE OREGON 8-6281 • CABLE RECTUSA

NEW YORK AREA OFFICE: 132 EAST 70TH ST., PHONE TRAFALGAR 9-3330 • CHICAGO AREA OFFICE: 205 W. WACKER DR., PHONE FRANKLIN 2-3888 • NEW ENGLAND AREA OFFICE: 17 DUNSTER STREET, CAMBRIDGE, MASS., PHONE UNIVERSITY 4-6520 • PENNSYLVANIA AREA OFFICE: SUBURBAN SQUARE BUILDING, ARDMORE, PENNA., PHONE MIDWAY 9-1428

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**CUSTOM BUILT TO YOUR SPECIFICATIONS**

Complete Contract Manufacturing Facilities for any type of metal enclosure . . . including more than 50 years experience of metal craftsmanship . . . are available to you at Kirk & Blum.

For control panels, transformer tanks, indoor or outdoor electrical housings . . . fabricated in sheet, plate, stainless, carbon steel, aluminum, monel or other alloys . . . call on Kirk & Blum.

Send your prints for prompt quotation.

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## TRADE LITERATURE

**Ship Dehumidification Bulletin.** Now available is Bulletin *R-30,* Ship Dehumidification Systems. Other bulletins available are Bulletin *DS-1,* Dehumidified Storage, and Bulletin *R-11-B,* Desomatic Driline Pressure Dehumidifiers. Write to Desomatic Products, Inc., 1109 W. Broad St., Falls Church, Va.

**Antistatic Plastic Compounds.** Three new static-free buffing compounds for cutting and coloring all types of plastics are described and pictured in a recently published bulletin. Containing a special ingredient which dissipates static electricity from the finished part, the new scratch-free compounds are *PC-52,* for medium to heavy cuts on thermoplastic or thermosetting materials, *PC-93,* for high color work on all types of plastics, and *PC-19,* for Lucite and Plexiglas. For copies of Plastic Compounds Bulletin, *PBC-100,* write to Paul Waalkes, Hanson–Van Winkle–Munning Co., Grand Rapids, Mich.

**Industrial Insulations Guide Book.** Application and specifications for a complete line of pressure sensitive electrical tapes and epoxy resins for electrical insulations are listed in a new 32-page guide book and catalog, free on request from Minnesota Mining and Manufacturing Co., 900 Bush St., St. Paul 6, Minn.

**ALCO *Review* Features.** Articles describing new advanced nuclear research laboratory and heat transfer engineering are featured the Winter issue of the *ALCO Products Review*. Introduced in the latest issue of the 26-page publication is "Alcoscope," a page of news-type announcements of general interest. Copies of the *Review* are available from ALCO Products, Inc., P. O. Box 1065, Schenectady, N. Y.

**Ductile Iron Digest.** A new metal as strong as carbon steel, tensile strength up to 200,000 psi is described in this 18-page digest. It can literally be twisted and bent without cracking, and has as much as 30% elongation. Contact Reader Service Section, The International Nickel Company, Inc., 67 Wall St., New York 5, N. Y., for further information.

**Wrought Iron Booklet.** A booklet prepared on the subject of Underwriters Laboratories approved corrosion resistant wrought iron conduit has been published. Included in the 8-page, illustrated booklet is a discussion of wrought iron's unique composition and a description of the added corrosion protection provided by the sherardizing method of galvanizing and *MCV-1* acid resistant vinyl enamel processing. A copy of "National Electric Wrought Iron Electrical Conduit" can be obtained by writing National Electric Products Corporation, Room 900, 2 Gateway Center, Pittsburgh 22, Pa.

*(Continued on page 58A)*

*for*
***HEARING***
***AIDS***

302 STAINLESS CASE
TRANSFORMER 4750
MAGNETIC MICROPHONE COMPONENTS – 4750
MAGNETIC AIR RECEIVER COMPONENTS – 4750
MAGNETIC BONE RECEIVER COMPONENTS – 4750

*or*
***RECORDING***
***HEADS***

TAPE RECORDER HEAD – 4750 COMPONENTS
WIRE RECORDER HEAD – 4750 COMPONENTS

**or __*ANY*__ MAGNETIC MATERIALS JOB . . .**

*Write for your Copy*

**"MAGNETIC MATERIALS"**

MAGNETIC MATERIALS

This 32-page book contains valuable data on all Allegheny Ludlum magnetic materials, silicon steels and special electrical alloys. Illustrated in full color, includes essential information on properties, characteristics, applications, etc. Your copy gladly sent free.

**ADDRESS DEPT. EL-4**

You can *rely* on core materials like the Allegheny 4750 components illustrated above, in your receivers, recording heads or microphone assemblies.

In fact, whether your equipment is small or large, the extra-broad line of A-L magnetic materials will solve your magnetic core problems. It includes all grades of silicon steel sheets or coil strip, as well as Allegheny Silectron (grain-oriented silicon steel), and a wide selection of high-permeability alloys such as 4750, Mumetal, Permendur, etc.

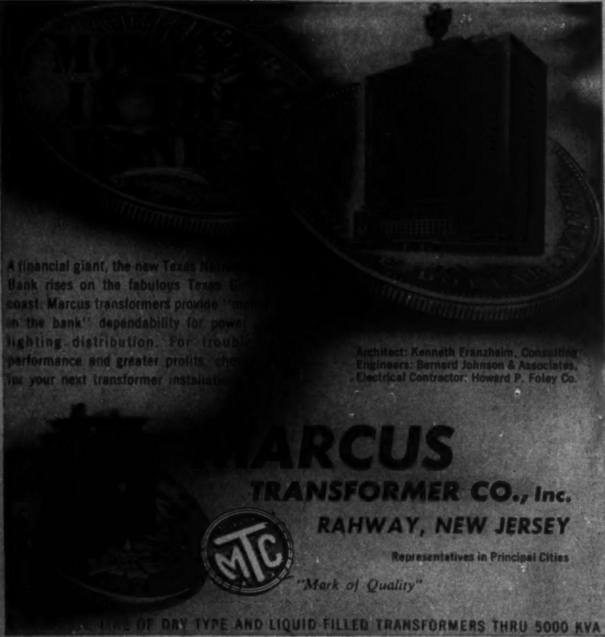
Our service on these materials also includes complete facilities for the fabrication and heat treatment of laminations. (For users of electrical sheets and strip, our lamination know-how is a real bonus value!) Either way, we'll welcome the chance to serve you. *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.*

**__STEELMAKERS__ to the Electrical Industry**

**Allegheny Ludlum**

W&D 5335

AL ®
STEELS FOR THE ELECTRONIC AGE


A financial giant, the new Texas National Bank rises on the fabulous Texas Gulf coast. Marcus transformers provide "money in the bank" dependability for power and lighting distribution. For trouble-free performance and greater profits, choose Marcus for your next transformer installation.

Architect: Kenneth Franzheim, Consulting Engineers: Bernard Johnson & Associates, Electrical Contractor: Howard P. Foley Co.

**MARCUS TRANSFORMER CO., Inc.**
**RAHWAY, NEW JERSEY**
Representatives in Principal Cities

MTC "Mark of Quality"

[illegible] LINE OF DRY TYPE AND LIQUID FILLED TRANSFORMERS THRU 5000 KVA

For Missile Testing

and general use

30 to 300 Amps

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**CHRISTIE**
**SILICON**
**POWER**
**RECTIFIERS**

Available in Industrial and Military types. Military type meets specs MIL-E-4970 and MIL-I-6181. Other stationary and mobile styles available up to 1500 Amps.

Write for Bulletin AC-58-A

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Over a Quarter Century of Rectifier Manufacturing

**ambitious?**

**OPPORTUNITIES WHICH LEAD TO MANAGEMENT**

As an independent leader in the field of high permeability magnetics, we are expanding our creative engineering leadership. These are "threshold to management" positions for which we need

**ELECTRICAL AND ELECTRONIC ENGINEERS**

Choose your own avenue of development or application work in instrumentation, magnetic circuitry and magnetic materials.

*If you can qualify for a really bright future, send experience summary to*

**Mr. Keith Krewson, Mgr. of Personnel**

**MAGNETICS Inc.**
**BUTLER 2, PA.**
*(near metropolitan Pittsburgh)*

## Trade Literature

*(Continued from page 56A)*

**Electrical Control Equipment Brochure.** A 64-page brochure gives detailed information, technical data, and prices on all types of automatic electrical control equipment. Applications, construction details, engineering information, and operating features are included, as well as general data and design specifications. It is conveniently indexed in four sections, covering automatic transfer switches, contactors, special controls, and timing devices. A copy of this catalog can be obtained by request on company letterhead. Write Zenith Electric Company, Dept. EGN, 152 W. Walton St., Chicago 10, Ill.

**Electronic Facilities and Products Brochure.** A 46-page brochure setting forth the design, engineering, and manufacturing facilities, and showing typical electromechanical and electronic products and systems in the fields of power supplies, actuators, blowers, timing devices, and inverters as used in the manufacture of aircraft and missiles has been issued by Western Design & Manufacturing Corp., a Division of U. S. Industries, Inc., Santa Barbara Airport, Goleta, Calif.

**Reinforced Molding Compounds Catalog.** A paper-bound 40-page catalog describing the Atlac Thermaflow reinforced polyester molding compounds is now available without charge from the Atlas Powder Company, Chemicals Division, Wilmington 99, Del. According to the manufacturer, the Atlac Thermaflow compounds are unique materials offering high impact strength, and unusual electrical and chemical resistant qualities. The catalog suggests that these compounds can replace metals and other plastics in many applications.

**Plastics File and Carbowax Booklet.** The 1958 edition of the "Condensed Reference File" describes in easy, readable terms the major families of plastics produced by Bakelite Company. The 12-page booklet is profusely illustrated and has thumb-indexes to aid in finding data on polyethylenes, vinyls, styrenes, phenolics, and epoxies. The broadest range of plastics materials available from a single source is shown. The 1958 Condensed Reference File can be obtained by writing to Bakelite Company, Division of Union Carbide Corporation, 30 E. 42nd St., N. Y. 17, N. Y. Published by another division of Union Carbide Corporation is a 54-page booklet on the properties, applications, storage, specifications, and testing of Carbowax polyethylene glycol. Carbowax polyethylene glycols are water-soluble, nonvolatile, unctuous liquids and solids used for water-soluble lubricants, cosmetics and ointments, emulsifying agents, adhesives, and paper coatings. Copies of the booklet are available from Union Carbide Chemicals Company, Division of Union Carbide Corporation, 30 E. 42nd Street, New York 17, N. Y.